MASS. TU1.2:EV13

UMASS/AMHERST

312066016678891

Evaluating Progress

A Report on the Findings of the Massachusetts Toxics Use Reduction Program Evaluation

March 1997

OCT 17 1997

DOCUMENTS COLLECTION
UNIVERSITY OF MASSACHUSETTS

prepared by
The Massachusetts Toxics Use Reduction Program

EXECUTIVE OFFICE of ENVIRONMENTAL AFFAIRS

Office of Technical Assistance

TOXICS USE REDUCTION INSTITUTE

Toxic Use Reduction Institute

DEP

Department of Environmental Protection

EVALUATING PROGRESS

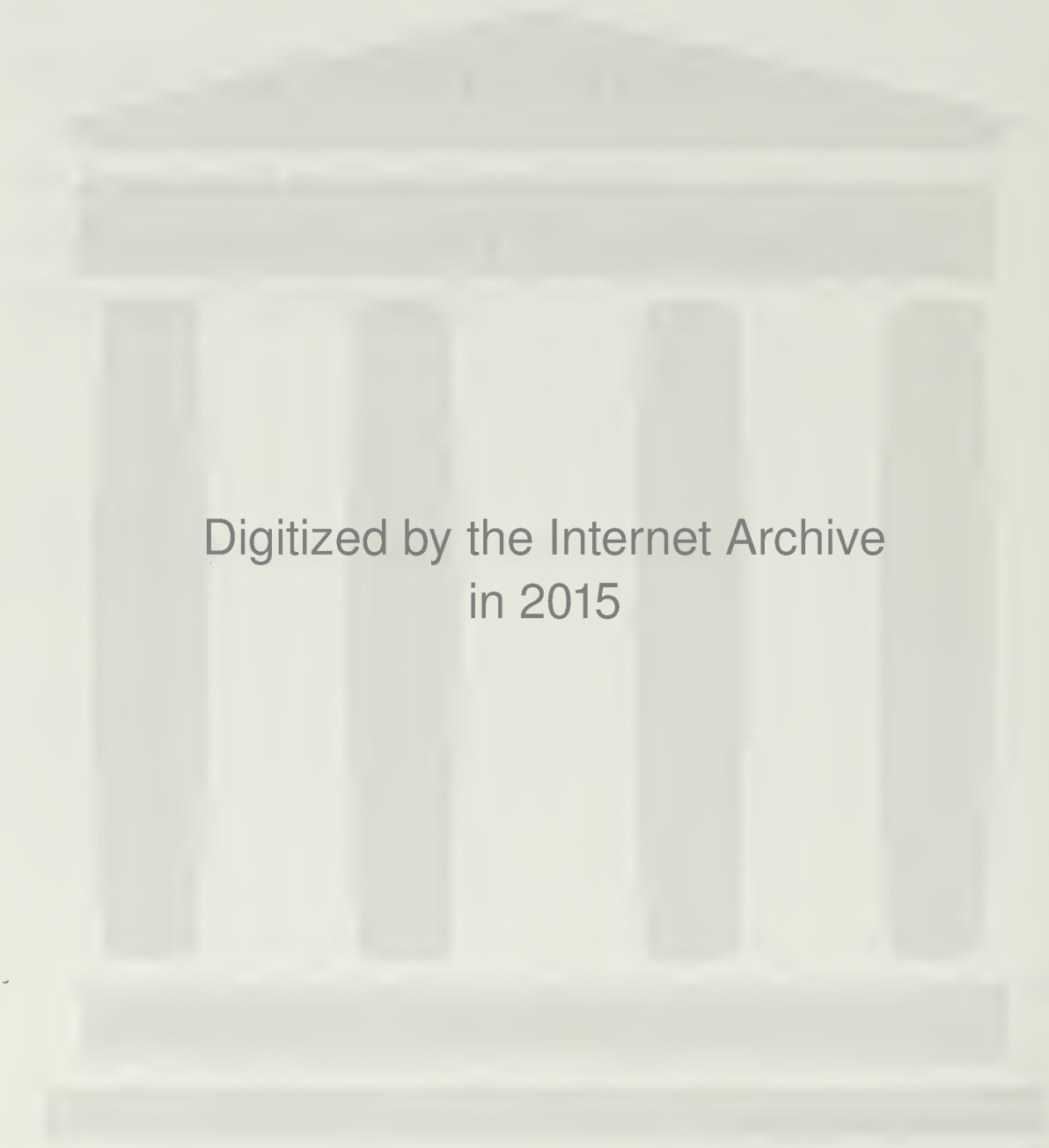
A Report on the Findings of the Massachusetts Toxics Use Reduction Program Evaluation

prepared by
The Massachusetts Toxics Use Reduction Program

March 1997

principal authors

Monica Becker
Ken Geiser
Toxics Use Reduction Institute
University of Massachusetts Lowell



Digitized by the Internet Archive
in 2015

https://archive.org/details/evaluatingprogre00mass_0

Executive Summary

In 1989 the legislature of the Commonwealth of Massachusetts unanimously passed the Toxics Use Reduction Act (TURA) which created the Massachusetts Toxics Use Reduction Program. A central goal of TURA (M.G.L. Chapter 211) is to cut in half by 1997 the quantity of toxic and hazardous wastes generated by Massachusetts industries – using toxics use reduction (TUR) techniques – while enhancing the capacity of Massachusetts businesses to grow and prosper. The Toxics Use Reduction Act was the product of a long negotiation process between business and environmental interests, resulting in a bill endorsed by both. Approximately 600 Massachusetts firms participate in the TURA program.

Toxics Use Reduction is defined in the Act as:

> "...in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product, so as to reduce risk to the health of worker, consumers or the environment, without shifting risks between workers, consumers, or parts of the environment."

In the summer of 1995, the agencies charged with administering the Toxics Use Reduction Act began an evaluation of the Toxics Use Reduction program. The agencies formed a planning group to coordinate the planning and implementation of the evaluation. The Toxics Use Reduction Institute spearheaded this effort. In designing the evaluation the planning group obtained advice and assistance from a consultation group made up of representatives of various interested stakeholders.

This report presents the findings of the TURA program evaluation. It draws together the results of several efforts:

- **Three significant studies conducted by independent contractors**
  - A survey of the 1993 TURA filers with 434 of 645 (or 67%) firms responding
  - An in-depth investigation of TUR at 25 Massachusetts manufacturers
  - A social benefit-cost analysis of the TURA program
- **An inventory and assessment of the programs and activities undertaken by the TURA agencies in fulfillment of the mandates of the Toxics Use Reduction Act**
- **Analysis of the TURA data**

Four major questions are posed and addressed in this evaluation:

1. Did the firms and agencies implement the law?
2. What happened to toxic chemical use and byproducts?
3. How valuable are the program elements and resources?
4. What are the costs and benefits of the TURA program?

Did the TURA Firms and Agencies Implement the Law?

The evaluation found that Massachusetts TURA firms are making significant efforts to implement the law by changing their practices and processes to reduce their dependance on toxic chemicals and generation of toxic wastes. The survey of TURA filers indicates that TURA firms have significantly increased their involvement in key TUR practices since implementation of TURA in 1990 to the present. Only 30% of TURA firms were reviewing changes in production processes for their environmental, health and safety impact in 1990 while 76% report doing so today. Eighty one percent of survey respondents stated that they have or will implement *at least* a few of the projects selected for implementation in their TUR plan and all 22 TURA firms studied in the in-depth investigation were found to have implemented TUR projects between 1990 and 1996. Barriers to TUR implementation do exist; in the survey, a large number of respondents stated that company concern with impact on product quality and customers not accepting change in products are the chief barriers to TUR.

Facility Involvement in Toxics Use Reduction Activities, Before 1990 and Now*

Activity	*Percentage of respondents "very involved" in [activity]***	
	Before 1990	*Now*
1. Tracking quantities of wastes generated	49%	89%
2. Tracking quantities of chemicals used	48%	90%
3. Establishing a corporate or facility environmental team	24%	68%
4. Setting goals for waste reduction	24%	73%
5. Reviewing changes in production processes for their environmental, health and safety impact	30%	76%
6. Allocating environmental costs to processes or products	21%	52%

*Total number of facilities = 434, Survey administered in June-July, 1996.
**Note: only "very involved" responses shown. Other responses were: somewhat involved and not at all involved.

Furthermore, the survey data show a clear connection between TUR implementation and reductions in byproduct generation and toxic chemical use. Survey respondents were asked if their facility's net byproduct generation and toxic chemical use (per unit of total production) had increased, decreased or remained unchanged since 1990. The survey researchers found the following:

Of the facilities that said they have or will implement at least a few of the projects *identified in their TUR plans*:

- 61% reported that they have *decreased* their byproduct generation since 1990,
  and
- 67% reported that they *reduced* their toxic chemical use during the same time frame.

Whereas, of the firms that have <u>not</u> implemented any of their identified TUR projects:

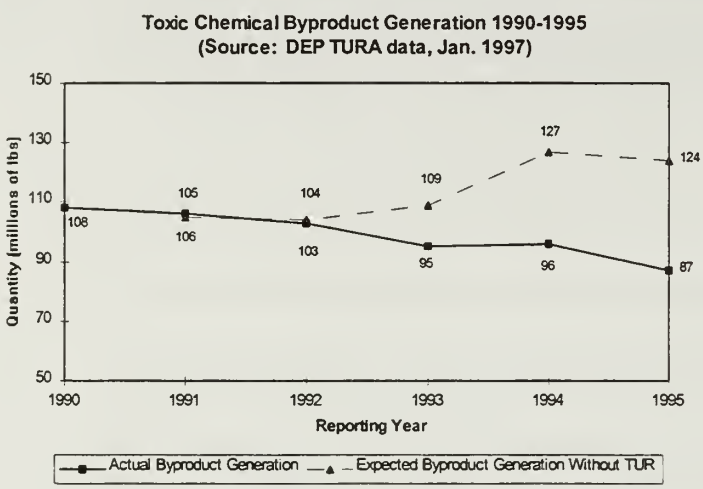
- 61% reported that byproduct generation has *increased or remained unchanged* since 1990,
  and
- 66% reported that toxics use has *increased or remained unchanged*, during the same time frame.

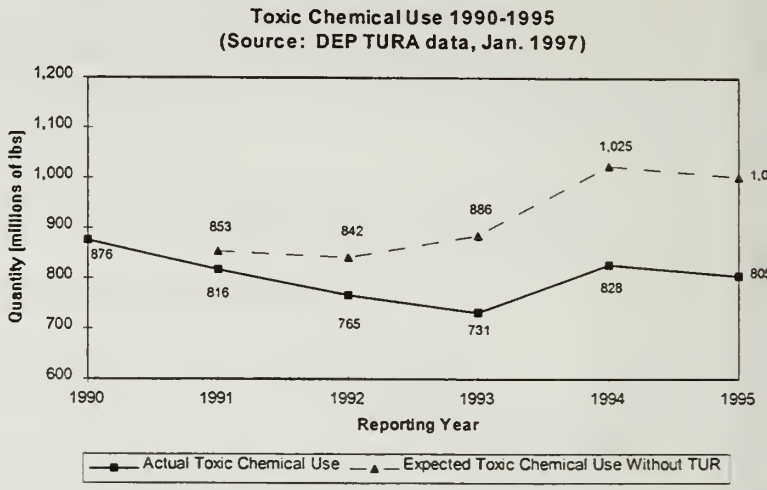
Therefore, it appears that TUR implementation has resulted in reductions in byproduct and use in a significant number of companies, and lack of implementation shows the opposite effect.

Since the inception of the TURA program, the TURA agencies have put in place numerous and varied programs and activities supporting toxics use reduction, involving members of Massachusetts industry and the general public. The Toxics Use Reduction Act contained 55 mandates and 14 discretionary tasks to be accomplished by the TURA program agencies. An accounting of these mandates shows that the agencies have fulfilled a total of 45 (or 82%) of these mandates. Ten of the 55 mandates (or 18%) have not yet been fulfilled. These statistics show that the program agencies have fulfilled most of the numerous and complex mandates of the law.

What happened to Toxic Chemical Use and Byproducts?

Massachusetts industries are making progress in toxics use reduction. Between 1990 and 1995, the six years for which TURA data exists, byproduct generation declined by 30% and toxic chemical use dropped by 20%. These figures have been normalized to take into account changes in levels of production. According to the survey, 55% of facilities decreased their byproduct generation and 60% decreased their use of toxic chemicals per unit of total production, since 1990. The following two graphs demonstrate these data trends.





How Valuable are the TURA Program Elements and Resources?

The firms were asked about the value of TUR implementation, planning, reporting and the resources available to them under the TURA program. The most frequently reported benefits of TUR implementation were cost savings (67% of respondents) and worker health and safety (66%). Seventy percent, or 302 out of 434 survey respondents indicated that they had identified TUR opportunities *as the result of* their 1994 plan. Of the 21 firms in the in-depth investigation that had conducted TUR planning, 11 stated that planning was a major factor in driving them to consider and implement TUR. Four firms stated that planning was important but not a major factor and six firms failed to implement TUR through planning. Of the six that had not implemented TUR, three indicated that they did not believe *a priori* that planning would be productive and devoted few resources to it. Of 22 TURA firms interviewed, six stated that the annual reporting requirements provided benefits for their operations including: better information about materials in products, processes and waste streams, as well as providing a priority list of chemicals for TUR efforts. Twelve of 22 respondents reported that the collection of data for Form S reporting provided no benefit to their operations.

In the survey TURA agency services were found to be "very" or "somewhat" useful in implementing toxics use reduction by almost all of the respondents that have had exposure to them. Toxics use reduction planner training and site visits from the Office of Technical Assistance (OTA) were regarded as the most useful TURA resources.

What are the Benefits and Costs of the TURA Program?

The study of the benefits and costs of TURA concluded that the benefits of TURA to the Commonwealth exceed the costs of TURA for the period 1990 to 1997. This conclusion was reached purely on the basis of monetized costs and benefits as reported by TURA firms and is exclusive of the non-monetized human health and ecological benefits of the Act. The study identified $77 million as the total costs of implementing the TURA program and total *monetized* benefits of $91 million. The monetized benefits should be considered only a partial picture of the benefits of the TURA program because the value associated with the human health and ecological benefits of the Act, benefits to non-TURA firms, and several other benefits were not monetized.

Is the TURA Program Meeting the Six Policy Goals of the Act?

The TURA program has made great progress toward meeting the six goals stated in the Toxics Use Reduction Act.

The first goal involves reducing the generation of toxic wastes by 50% from 1987 to 1997. It is not yet possible to determine whether the goal will be reached since TURA waste data are only available for the period 1990 to 1995 and the results of efforts to estimate the 1987 baseline are inconclusive. What can be said, however, is that the TURA data indicate a very significant reduction of 30% in byproduct resulting from TUR during the period 1990-1995. This period represents five years of reporting by TURA firms, where byproduct reductions averaged 6% per year.

The second goal establishes TUR as the preferred means of compliance with environmental laws. Through the Department of Environmental Protection's (DEP) multimedia inspection program, Massachusetts is making strides toward establishing toxics use reduction as the preferred means of achieving compliance with the environmental laws – federal and state – under its purview. This evaluation found that when TUR *was* addressed in an inspection, results were impressive; two out of three firms receiving TUR recommendations implemented them. However, the evaluation also found several notable shortcomings of the program. TURA agencies have been working with other state agencies to help promote TUR in non-environmental regulatory programs such as those focused on worker health and safety and on radioactive wastes.

The third goal promotes the competitive advantage of Massachusetts businesses.

This evaluation provides evidence that firms are indeed lowering their production costs through TUR. Sixty seven percent of survey respondents that had reported implementing TUR said that they actually saw direct cost savings (e.g., on materials use or waste disposal) and 66% reported that they realized improvements in worker health and safety. Thirty eight percent of survey respondents stated that TUR has improved their firms environmental image and 27% claim TUR created a marketing advantage While only a minority of respondents reported reduced regulatory compliance requirements (45%) this number is not insignificant considering the financial benefits of reduced regulatory cost. However, a notable majority of survey respondents answered that company concern with impact on product quality was an important factor in their company's decisions not to implement TUR projects.

The fourth goal seeks to reduce the production and use of toxic hazardous substances.

Good progress is being made toward this goal. From 1990 to 1995 toxic chemical use, (i.e., the sum total of chemicals manufactured, processed or otherwise used) dropped by 20% as a result of toxics use reduction. The survey found that 60% of facilities decreased their use of toxic chemicals per unit of total production since 1990. This evaluation establishes a strong connection between these reductions and the programs and resources of the TURA program by documenting the significant impact that planning under TURA and other program resources have had on motivating or assisting firms to implement TUR. The evaluation cannot, however, draw conclusions about the impact of other state regulatory programs on progress in toxic chemical production and use reductions.

The fifth goal seeks to enhance and strengthen the enforcement of existing environmental laws.

By incorporating a multi-media focus into its regulatory enforcement programs, DEP has made significant strides toward increasing the effectiveness of enforcement efforts. The multi-media inspections simultaneously check for compliance with applicable environmental rules for air, industrial wastewater, hazardous waste, and TURA. In addition, the TURA agencies, and OTA in particular, have lent their expertise to a number of important programs aimed at strengthening a variety of state and federal environmental regulatory programs.

The sixth goal promotes coordination between state toxics-related programs.

The evaluation found that the TURA agencies have undertaken many joint efforts with other state entities involved in toxics-related programs. These include the Attorney General's Office, the Division of Energy Resources, the Industrial Finance Agency, the Department of Public Health, the Department of Procurement and General Services, the Office of Business Development, the University of Massachusetts and the Massachusetts Water Resources Authority.

Implications from the Evaluation for TURA Program Improvements

The survey asked respondents in an open-ended question to identify changes that they would recommend for the TURA program. Respondents offered a wide range of suggestions for improving TURA: Twelve percent recommended eliminating the program while 14% recommended leaving it unchanged. The largest number of responses (19%) involved reducing the paperwork burden and simplifying the procedures. Another 16% of responses recommended changes to the toxic chemical list.

While suggestions from survey respondents provide valuable input for improving the TURA program, other results from throughout the evaluation provide implications for program improvements as well. These include:

- **Outstanding mandates.** Not all of the TURA mandates have been fulfilled. Unfulfilled mandates include: the consolidation of all reporting on chemical use, release and disposal; and development of an electronic system for filing TURA data.

- **Barriers to TUR.** The evaluation sought to elucidate barriers to TUR implementation. Based on the survey results, the most significant barriers appear to be company concern with impact on product quality, and customers not accepting change in the product. These barriers should be examined further, particularly to determine whether major technological gaps exist that impede firms from pursuing TUR.

- **Rewarding Leaders; Encouraging the Others.** Clearly many firms are making good progress toward toxics use reduction and others are finding the task more difficult. Consideration should be given to rewarding leaders and focusing resources on those firms that have not achieved great success with TUR.

- **Small Quantity Toxics Users.** The evaluation shows good progress in toxics use reduction among those firms subject to the requirements of TURA. It is not clear that the smaller quantity toxics users in the Commonwealth are making the same progress.

- **Other Areas of Human and Environmental Impact.** TURA is focused on reducing the adverse impacts of toxic chemical use by the industries covered by the Act. It appears that there may be great benefits if firms applied the principles of TUR planning to other important areas with environmental and health consequences, e.g., water use, energy use, the impact of the product when used, recycled, and discarded by consumers.

Acknowledgments

This report is the result of the efforts of many individuals. The Toxics Use Reduction Program Evaluation was charted by a planning group made up of representatives of the TURA program agencies. The individuals involved were: Gina McCarthy of the Executive Office of Environmental Affairs; Ken Geiser and Monica Becker of the Toxics Use Reduction Institute; Barbara Kelly, Rick Reibstein, Rich Bizzozero, and Bill McGowan of the Office of Technical Assistance; and Bill Panos and Steve DeGabriel of the Department of Environmental Protection. The Toxics Use Reduction Institute spearheaded this effort.

The evaluation planning group sought advice and assistance from a multi-stakeholder consultation group. The program evaluation consultation group included representatives from the TURA Advisory Board, TURA filers, environmental organizations, and individuals expert in the field of program evaluation; their names are listed on the following page. The consultation group's input on the design and implementation of the evaluation was invaluable.

This report draws from three studies performed under contract to the Toxics Use Reduction Institute. A survey of large quantity toxics users was conducted by Abt Associates of Cambridge, Massachusetts; an in-depth investigation of toxics use reduction in 25 firms was conducted by Greiner Environmental of Gloucester, Massachusetts; and a benefit-cost analysis of the TURA program was conducted by Abt Associates. Cheryl Keenan, Randi Currier, Josh Kanner and Chris Van Atten from Abt Associates and Tim Greiner from Greiner Environmental were principally responsible for these studies.

Several individuals deserve special thanks for their contributions to this report, Liz Harriman and Anne Berlin Blackman from the Toxics Use Reduction Institute, Steve McKenna from the Department of Environmental Protection, Maureen Hart from Hart Environmental Data, Cynthia Barakatt from the Office of Technical Assistance, and Julie Brody from Silent Spring Institute.

Monica Becker and Ken Geiser were the principal authors of this report.

Members of the TURA Program Evaluation Consultation Group

Geoff Beckwith
Mass Municipal Association

Paul Burns
MASSPIRG

Brian Clarridge
UMass Boston
Center for Survey Research

Lori Columbo
Environmental Futures

Harry Fatkin
Polaroid Corporation

Jim Gomes
Environmental League of Massachusetts

Edward Jamro
Monsanto Chemical Company

Gretchen Latowsky
John Snow Institute

George Lemos
Earth Tech

Keith McCoy
Associated Industries of Massachusetts

Kevin McManus
MA Water Resources Authority

Joel Pointon
Toxics Use Reduction Planners Association

Alicia Raddatz
Morton International Inc.

Richard Tuck
CPC Incorporated

Table of Contents

EXECUTIVE SUMMARY ii

ACKNOWLEDGMENTS ix

MEMBERS OF THE TURA PROGRAM EVALUATION CONSULTATION GROUP x

1. BACKGROUND AND INTRODUCTION 1
   1.1 The Toxics Use Reduction Program in Brief 1
   1.2 Purpose of the TURA Program Evaluation 5
   1.3 Components of the TURA Program Evaluation 5
      1.3.1 Data Analysis 5
      1.3.2 TURA Mandates Fulfillment Analysis 6
      1.3.3 Survey Evaluation of the TURA Program 6
      1.3.4 In-Depth Investigation of Toxics Use Reduction in 25 Massachusetts Firms 7
      1.3.5 Benefit-Cost Analysis of TURA 8

2. FINDINGS 11
   2.1 Did the TURA Firms and Agencies Implement the Law? 11
      2.1.1 Did the TURA Firms Implement the Law? 11
      2.1.2 Did the TURA Agencies Implement the Law? 15
   2.2 What happened to Toxic Chemical Use and Byproducts? 20
      2.2.1 A Look at 1990-1995 20
      2.2.2 Will Massachusetts Achieve the Goal of 50% Byproduct Reduction Between 1987 and 1997? 24
   2.3 How Valuable are the TURA Program Elements and Resources? 26
      2.3.1 TUR Implementation 26
      2.3.2 Planning 29
      2.3.3. Reporting 32
      2.3.4 TURA Program Resources 34
   2.4 What are the Benefits and Costs of the TURA Program? 38
      2.4.1 Costs of TURA 38
      2.4.2 Benefits of TURA 39

3. CONCLUSIONS 43
   3.1 Is the TURA Program Meeting the Six Policy Goals of the Act? 43
   3.2 Implications from the Evaluation for TURA Program Improvements 48

Table of Contents (continued)

Appendix A
Analysis of TURA Mandates A-1

Appendix B
Grants Received by the TURA Program for TUR Activities B-1

Appendix C
Two Case Studies of Toxics Use Reduction Planning C-1

Appendix D
An Analysis of Reductions of Ethyl Acetate Releases and Sulfuric Acid Use on Occupational Health and Safety D-1

Table of Figures

Figure 1 Companies Studied in the In-Depth Investigation 8
Figure 2 Overview of Benefit-Cost Analysis of TURA Program 10
Figure 3 Facility Involvement in Toxics Use Reduction Activities, Before 1990 and Now . . . 12
Figure 4 Barriers to TUR Project Implementation 14
Figure 5 Toxic Chemical Byproduct Generation 1990-1995 22
Figure 6 Toxic Chemical Use 1990-1995 22
Figure 7 Benefits from TUR Project Implementation 27
Figure 8 Other Benefits from Implementing TUR Projects, Provided by Respondents 27
Figure 9 Association of SIC Code with Extent to Which Companies Saw Cost Savings 28
Figure 10 Qualitative Benefits of Planning Reported in the In-Depth Investigation 30
Figure 11 Value of TUR Planning Components 31
Figure 12 Contribution of the TUR Planning Process to TUR Practices 31
Figure 13 Experience With and Opinion Of TURA Program Resources 35
Figure 14 Monetized and Non-monetized Costs and Benefits of TURA 40
Figure 15 Summary of TURA Costs ($ 1995 - millions) 41
Figure 16 Net Changes in the Operating Costs of TURA Filers Resulting from TURA Activities 41
Figure 17 Joint Efforts Between TURA Agencies and Other State Entities 47
Figure 18 Survey Responses to the Question "What would you change about the TURA program" 48
Figure D-1 TUR Techniques Implemented to Reduce Ethyl Acetate Use D-3
Figure D-2 Production Weighted Emission Reductions of Ethyl Acetate (1990-1994) D-3
Figure D-3 TUR Techniques Implemented to Reduce Sulfuric Acid Use D-5

1. BACKGROUND AND INTRODUCTION

In the summer of 1995, the agencies charged with administering the Toxics Use Reduction Act began an evaluation of the Toxics Use Reduction Program (TURA program). The agencies formed a planning group made up of two representatives from each agency to coordinate the planning and implementation of this evaluation. The Toxics Use Reduction Institute spearheaded this effort. The evaluation planning group obtained advice and assistance from a multi-stakeholder consultation group made up of representatives from the TURA Advisory Board, TURA filers, environmental organizations, and individuals expert in the field of program evaluation. The consultation group provided input on the design and implementation of the evaluation. The names and affiliations of the consultation group are listed in the Acknowledgments.

This report presents the findings of the TURA program evaluation. It draws together the results of several efforts:

- **Three significant studies conducted by independent contractors**
  - A survey of the 1993 TURA filers with 434 of 645 (or 67%) firms responding
  - An in-depth investigation of TUR at 25 Massachusetts manufacturers
  - A social benefit-cost analysis of the TURA program
- **An inventory and assessment of the programs of the TUR agencies**
- **Analysis of the TURA data**

1.1 The Toxics Use Reduction Program in Brief

In 1989 the Massachusetts legislature unanimously passed the Toxics Use Reduction Act (TURA) which created the Massachusetts Toxics Use Reduction Program. A central goal of TURA (M.G.L. Chapter 211) is to cut in half by 1997 the quantity of toxic and hazardous wastes generated by Massachusetts industries – using toxics use reduction (TUR) techniques – while enhancing the capacity of Massachusetts businesses to grow and prosper. The Toxics Use Reduction Act was the product of a long negotiation process between business and environmental interests, resulting in a bill endorsed by both. Approximately 600 Massachusetts firms participate in the TURA program.

Toxics Use Reduction is defined in the Act as:

> "...in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product, so as to reduce risk to the health of worker, consumers or the environment, without shifting risks between workers, consumers, or parts of the environment."

The Act establishes six TUR techniques:

- **Input substitution** - replacing a toxic or hazardous substance or raw material used in a production unit with a non or less toxic substance
- **Product reformulation** - substituting for an existing end-product an end-product which is not or less toxic upon use, release or disposal
- **Production unit redesign or modification** - developing and using production units of a design different than those currently used
- **Production unit modernization** - upgrading or replacing existing production unit equipment and methods
- **Improved operations and maintenance** - improving housekeeping practices, adjusting operating systems, improving process control
- **Closed-loop recycling** - recycling, reuse or extended use of toxics by using equipment or methods which are integral to the production unit

The Act states that the policy goals of this act shall be:

Goal 1. To establish for the Commonwealth a statewide goal of reducing toxic waste generated by fifty percent (50%) by the year 1997 using toxics use reduction as the means of meeting this goal [Section 13 of the Act establishes a base year of 1987 for this goal][1];

Goal 2. To establish toxics use reduction as the preferred means for achieving compliance with any federal or state law or regulation pertaining to toxics production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics, or releases of toxics into the environment and for minimizing the risks associated with the use of toxic or hazardous substances and the production of toxic or hazardous substances or hazardous wastes;

Goal 3. To sustain, safeguard and promote the competitive advantage of Massachusetts business, large and small, while advancing innovation in toxic use reduction and management;

Goal 4. To promote reductions in the production and use of toxic hazardous substances within the Commonwealth, both through the programs established in section three of this act and through existing toxics-related state programs;

---

[1] Section 13(A) of TURA (M.G.L. Chapter 211) states:

> The goal of the Commonwealth is to achieve by 1997, through toxics use reduction, a fifty percent (50%) reduction from 1987 quantities of toxic or hazardous byproducts generated by industry in the Commonwealth of Massachusetts.

Goal 5. To enhance and strengthen the enforcement of existing environmental laws and regulations within the Commonwealth; and

Goal 6. To promote coordination and cooperation between all state departments and agencies administering toxics-related programs."

The Act applies only to companies that fall within certain Standard Industrial Classification (SIC) Codes including:

SIC Code(s)	Type of Business
10 through 14	Mining
20 through 39	Manufacturing
40, 44 through 49	Transportation
50, 51	Wholesale
72, 73, 75 and 76	Certain Services

Two other factors determine the applicability of TURA to a business. The business must employ the equivalent of ten or more full-time workers. In addition, the firm must annually manufacture or process at least 25,000 pounds or otherwise use at least 10,000 pounds of any chemical listed on a special state list made up of chemicals on the U.S. Environmental Protection Agency's Toxic Release Inventory (Section 313 of the Emergency Planning and Community Right to Know Act) or the federal Superfund Law (the Comprehensive Environmental Response Compensation and Liability Act, or CERCLA). Firms meeting these three criteria are considered "large quantity toxics users" (LQTUs) and have special obligations under TURA.

According to the Act LQTUs must:

- Submit annual toxics use reduction reports to the Department of Environmental Protection (DEP) -- the federal "Form R" and the state "Form S" -- for each listed chemical manufactured, processed or otherwise used in amounts equal to or in excess of 10,000 pounds per year. The Form S identifies the quantity of each listed chemical used, generated as byproduct and shipped as part of the finished product. Firms must identify each production process and product (called a production unit) using a listed chemical, and for each, the firm must calculate byproduct and emissions reduction indicies (so called "BRI" and "ERI"). These indicies measure the percentage change from a base year to the reporting year in byproducts or emissions generated per unit of product produced.

- Every other year develop a toxics use reduction plan or plan update and submit a summary to DEP. The plan must contain a corporate policy statement regarding TUR, an assessment of

how and in what quantities listed chemicals are used and generated as waste by the firm, an accounting of the full costs of using those chemicals, a list of available TUR options, evaluation of feasible options, and for each option that the firm will employ, a description and implementation schedule. For each listed chemical the plan must contain two- and five-year projections for facility-wide use and byproduct generation, BRIs for each production unit, and goals for reducing byproducts. Plans must be certified by a DEP-certified TUR planner. Only plan summaries are required to be submitted to DEP.

- Pay an annual fee in support of the state's TUR programs.

The Act requires that six public institutions share the job of supporting the goals of TURA:

The Department of Environmental Protection's Toxics Use Reduction Program (DEP) certifies TUR planners, receives and reviews reports submitted by companies subject to TURA requirements, receives TURA fees, enforces TURA regulations, manages collected data and makes it available to the public, and evaluates the state's overall progress as it works toward the TURA goals.

The Office of Technical Assistance for Toxics Use Reduction (OTA), part of the Executive Office of Environmental Affairs, provides free consultation and advice to firms that are attempting to implement TUR programs. OTA primarily serves small and medium-sized Massachusetts firms.

The Toxics Use Reduction Institute (TURI), on the campus of the University of Massachusetts Lowell, provides education and training in TUR for professionals and the general public, conducts a technology transfer program, and sponsors research into the development of safer and cleaner production materials, technologies and manufacturing methods.

The Administrative Coordinating Council brings together representatives of seven state agencies responsible for environmental protection, public health, occupational safety and economic development. The council is the coordinating body of the TURA program and is chaired by the Secretary of Environmental Affairs.

The Advisory Board is comprised of experts on business, industry, labor, the environment, and public health. Its primary role is to advise the Administrative Council on TUR policy issues. The board provides an open forum for discussion of TUR issues.

The Science Advisory Board advises TURI on the addition or deletion of chemicals to the list covered by TURA, priority user segments, and other related issues.

1.2 Purpose of the TURA Program Evaluation

The TURA program evaluation was designed to achieve four principle goals:

a. to address the law's requirement that the program assess itself against Goal 1 of the Toxics Use Reduction Act: a 50% reduction in toxic waste through toxics use reduction by the year 1997 based on 1987 quantities of byproduct generation;

b. to measure and assess the program's performance on Goals 2-6 of the Act and other dimensions of the TURA program;

c. to inform the public and the Massachusetts Legislature about the effectiveness of the TURA program; and

d. to facilitate program improvements based on evaluation data.

1.3 Components of the TURA Program Evaluation

1.3.1 Data Analysis

Under TURA, industrial facilities have been reporting on their use of toxic chemicals and generation of hazardous byproduct (wastes) since 1990. Each year as facility managers prepare to report toxic chemicals released to the environment or transferred off-site under the federal Toxics Release Inventory (TRI) they must also report on the use of those chemicals under the state TURA program. In this evaluation, the TURA and TRI data were key ingredients in the determination of progress toward goals 1 and 4 of the Act.[2] Because the collection of TURA data began in 1990, and the Act established 1987 as the baseline from which to measure the 50% byproduct reduction goal, it was necessary to develop and execute a plan to establish the 1987 baseline.[3] The results of this DEP-led effort are discussed in Section 2.2.2 of this report.

---

[2] See the Massachusetts Toxics Use Reduction Institute, "Measuring Progress in Toxics Use Reduction and Pollution Prevention," Technical Report No. 30, 1996.

[3] Although firms began reporting data under the federal TRI in 1987 this data could not be used to develop the 1987 baseline since byproduct, as defined by TURA, cannot be derived from TRI data.

Four metrics were selected to assess progress toward goals 1 and 4: actual and production-normalized changes in quantities of toxic chemicals generated as byproduct and toxic chemicals used. Production-normalized metrics take into account the fact that changes in toxic chemical use or byproduct generation are affected by changes in level of production as well as TUR efforts. Metrics for the years 1990 through 1995 were calculated. Progress in 1996 and 1997 will be assessed when TURA data for those years are available in February 1998 and 1999, respectively. Section 2.2.1 contains the results of these analyses.

1.3.2 TURA Mandates Fulfillment Analysis

The Toxics Use Reduction Act contains numerous mandates for the TURA program agencies. Appendix A of this report contains an inventory and assessment of the tasks, programs, and activities undertaken in fulfillment of these mandates. Additional documentation can be found in a TURA Program Archive established at the Toxics Use Reduction Institute.

1.3.3 Survey Evaluation of the TURA Program

An independent contractor, Abt Associates of Cambridge, Mass., was hired to develop and conduct a survey of 1993 TURA filers. The purpose of the survey was twofold: (1) to assess the effectiveness of the TURA program in promoting TUR in Massachusetts businesses, and (2) to collect data for a benefit-cost analysis of the TURA program. Abt conducted a *census*, rather than a random sampling of TURA firms, where *all 1993 TURA filers were contacted* to capture the input of the greatest number of firms.

Of the total survey population of 645 firms, 434 phone surveys were completed for a response rate of 67%. To control for bias Abt conducted an analysis of the respondent and non-respondent populations which indicated that survey respondents were representative of the overall TURA filing population. Several criteria were examined to determine if the non-respondent and respondent populations differed. Industry sector and chemical use were two of the criteria evaluated. Overall, the seven largest industry sectors (based on 2-digit SIC codes) in the survey population accounted for 73% of facilities in the respondent population and 74% of facilities in the non-respondent population. Each of the top seven sectors was also compared individually and found to be very similar for the respondent and non-respondent populations. The analysis of chemical use for these populations also indicated that the respondent population was representative of the overall population of TURA-filers.

The survey was conducted in three parts: an advance letter, a telephone interview, and a facsimile portion. The advance letter was sent to all 645 1993 TURA filers describing the evaluation project, the need for their participation, and notifying them that they would be receiving a phone call from an interviewer. The phone survey was designed to assess the effectiveness of the TURA program.

At the conclusion of the phone survey, participants were asked if they would be willing to participate in the fax portion of the survey. The objective of the fax survey was to determine what changes in operating and capital costs resulted from TURA activities, as well as what costs were associated with TUR plan preparation and Form S preparation. This data was utilized in an assessment of the benefits and costs of the TURA program as described in Section 1.3.5 below. Of the 434 respondents that participated in the phone survey, 420 agreed to participate and 215 faxes were ultimately returned with varying response rates for each of the five questions contained therein.[4] Abt analyzed the potential for responder bias for the fax survey using methods similar to those described for the phone survey (above). Again, the respondent and non-respondent populations were found to be almost identical.

1.3.4 In-Depth Investigation of Toxics Use Reduction in 25 Massachusetts Firms

Twenty five randomly-selected Massachusetts were the subject of an in-depth investigation of TUR activities. Twenty two of the firms were Large Quantity Toxics Users and TURA filers and three were Small Quantity Toxic Users and did not file under TURA. Conducted by Greiner Environmental under contract to TURI, this study was organized around four objectives: (1) to deepen understanding of whether and how firms in Massachusetts have implemented TUR; (2) to assess whether the TUR activities implemented by industries were motivated by TURA over and above what otherwise would have been implemented; (3) to assess the impact of specific components of the TURA program (e.g., planning, reporting, technical assistance, training and education) on a firm's environmental practices; and (4) to contribute to an assessment of benefits and costs of the TURA program.

The investigation entailed detailed on site interviews with company personnel, review of TUR plans, and analysis of Form S data.[5] Figure 1 provides an overview of the firms studied; the identity of companies are kept confidential.

---

[4] The results of the survey are published in the report "Survey Evaluation of the Massachusetts Toxics Use Reduction Program," January, 1997, prepared by Abt Associates under contract to the Toxics Use Reduction Institute.

[5] The results of the investigation are published in the report "In-Depth Investigation of Toxics Use Reduction in 25 Massachusetts Firms," March, 1997, prepared by Greiner Environmental under contract to the Toxics Use Reduction Institute.

Figure 1 Companies Studied in the In-Depth Investigation

Firm Description	LQTU	No. of Employees	Planner Type	Technical Assistance	Multimedia Inspection
Automotive Supplier	yes	480	limited		yes
Electronic Switch Maker		140	na	yes	yes
Job Shop Metal Finisher I	yes	40	general		
Food Manufacturer I	yes	280	general		
Food Manufacturer II	yes	300	general		
Paper Converter I	yes	170	limited	yes	yes
Paper Converter II	yes	200	limited		yes
Paper Converter III	yes	180	na	yes	
Membrane Manufacturer	yes	220	limited		yes
Heat Treater	yes	40	general		
Electrical Components	yes	5500	limited		yes
Coatings Supplier	yes	90	general		yes
Gear Manufacturer	yes	170	general		
Container Cleaning Firm	yes	10	general		yes
Job Shop Metal Finisher II	yes	110	general	yes	yes
Cable Manufacturer	yes	200	limited	yes	yes
Leather Processing Firm	yes	20	general	yes	yes
Metal Processor I	yes	90	limited		
Metal Processor II		180	na	yes	
Job Shop Painter	yes	60	general	yes	yes
Military Parts Producer	yes	250	limited	yes	yes
Plastic Extruder	yes	100	general	yes	
Pump Manufacturer		250	na	yes	
Job Shop Metal Finisher III	yes	30	limited		yes
Drum Reconditioner	yes	20	general		yes

1.3.5. Benefit-Cost Analysis of TURA

The TURA program commissioned an analysis of the benefits and costs of the TURA program. Conducted by Abt Associates of Cambridge, this study compares the costs and benefits of the TURA program, considering both costs and benefits accruing directly to TURA firms (i.e., private or internal costs and benefits) and benefits accruing to other members of the Commonwealth (i.e., public benefits).[6]

[6] The results of this analysis are published in the report "Benefit-cost Analysis of the Massachusetts Toxics Use Reduction Act (TURA), "December 2, 1996, prepared by Abt Associates, Inc. under contract to the Toxics Use

The analysis monetized costs and benefits to the extent that reliable estimates could be generated. Figure 2 provides an overview of the analysis. Two general cost categories were monetized: compliance costs and capital investments in toxics use reduction for TURA firms. Compliance costs are those regulatory expenses and fees that TURA firms incur to comply with TURA regulations. Capital investments include expenditures on plant and equipment for implementation of TUR projects. It should be noted that these investments are voluntarily undertaken by facilities and that toxics use reduction is often achieved without capital investment.

Two types of TURA program benefits were monetized: (1) operating cost savings resulting from implementation of TUR projects at TURA firms; and (2) federal grants to the TURA program for TUR services. Operating savings are calculated as net changes in operating costs. During the past seven years the TURA program has been awarded many federal grants that have assisted the program and the participating firms and these are included since they benefit the Commonwealth.

The analysis does not monetize the benefits of human health and ecological risk reduction due to the difficulty in isolating, measuring, and then monetizing impacts resulting from TUR. Therefore, the sum of monetized benefits significantly underestimates the benefits associated with the reductions in toxic chemical use and by-product generation achieved as a result of the Act. The analysis does provide several examples of chemicals for which quantitative data from TURA Form S reports indicate use or emission reductions that would reduce human health and ecological risk.

The benefit-cost analysis identified, but was unable to monetize, several additional categories of benefits of TURA including benefits to non-TURA firms in Massachusetts from TURA program resources. Again, this adds to the significant underestimation of the benefits of the TURA program. Therefore, to truly assess the impact of the TURA program the results of the monetized benefit-cost analysis should be considered in conjunction with the examples of human health and ecological benefits, as well as the other non-monetized benefits.

The analysis estimates the present value of the benefits and costs resulting from TURA during the period 1990-1997. This time period encompasses the seven years the Act has been in effect plus projections to 1997, the year corresponding to the goal of 50 percent by-product reductions stated in the Act. The time period covers both the program start-up as well as more recent years in which the requirements of the Act have become familiar to industry and administration of the Act has been consistently funded.

Several sources of data were used in estimating the benefits and costs attributable to TURA: 1) Annual Report of the Administrative Council on Toxics Use Reduction, 2) the fax survey and

---

Reduction Institute.

phone survey administered by Abt Associates Incorporated (described in Section 1.3.3 above); 3) DEP TUR information system data files; 4) the in-depth investigation of TURA filers; 5) financial records from TURI's Program Income Account; and 6) financial records from DEP.

Figure 2 Overview of Benefit-Cost Analysis of TURA Program

Costs	Benefits
Monetized	
Compliance Costs: -Form S preparation -TUR plan preparation -Form S filing fees -Other TURA fees (TUR planner training, continuing education, certification) Capital investments	Savings in operating costs (=net operating cost changes) Federal grants to TURA program for TUR activities in Massachusetts
Non-Monetized	
	Human health and ecological benefits from: -reduced worker health and safety risks from exposure to toxic chemicals -reduced public health and safety risks from exposure to toxic chemicals -reduced environmental exposure to toxic chemicals Increased revenue from TUR improvements in processes and products Activities of TURA program agencies in other regulatory and non-regulatory programs Benefits to non-TURA firms in Massachusetts from TURA program resources Value of TURA data to public data users in the Commonwealth

2. FINDINGS

The findings of the evaluation are organized into the following four sections:

2.1 Did the Firms and Agencies Implement the Law?
2.2 What happened to Toxic Chemical Use and Byproducts?
2.3 How Valuable are the TURA Program Elements and Resources?
2.4 What are the Costs and Benefits of the TURA Program?

2.1 Did the TURA Firms and Agencies Implement the Law?

2.1.1 Did the TURA Firms Implement the Law?

Answer: Massachusetts TURA firms are making significant efforts to implement the law. The survey of TURA filers indicates that TURA firms have significantly increased their involvement in key TUR practices since implementation of TURA in 1990 to the present. Only 30% of TURA firms were reviewing changes in production processes for their environmental, health and safety impact in 1990 while 76% report doing so today. Eighty one percent of survey respondents stated that they have or will implement *at least* a few of the projects selected for implementation in their TUR plan and all 22 TURA firms studied in the in-depth investigation were found to have implemented TUR projects between 1990 and 1996. Barriers to TUR implementation do exist; in the survey a large number of respondents stated that company concern with impact on product quality and customers not accepting change in products are barriers to TUR.

Under the Toxics Use Reduction Act, firms covered by TURA are required to fulfill numerous requirements to implement their part of the law. Firms must submit annual TUR reports (the Form S), develop biennial TUR plans, and pay an annual TUR fee. TURA firms have a strong encouragement, rather than a requirement, to implement TUR practices and projects to the extent feasible. Just as the TURA public agency partners have a duty to work toward the achievement of the goals of the law, so too the industry partners share in the responsibility to meet the goals of TURA. In order to examine whether TURA firms have implemented the law, this section examines how firms are implementing TUR practices and projects.

TUR Practices

The survey documented a significant shift in TUR-type environmental practices at TURA firms from 1990 to the present. The survey results indicate that a large number of TURA firms have increased their involvement in six key areas of environmental management (see Figure 3).

Figure 3 Facility Involvement in Toxics Use Reduction Activities, Before 1990 and Now*

Activity	*Percentage of respondents "very involved" in [activity]***	
	Before 1990	*Now*
1. Tracking quantities of wastes generated	49%	90%
2. Tracking quantities of chemicals used	48%	90%
3. Establishing a corporate or facility environmental team	24%	98%
4. Setting goals for waste reduction	24%	73%
5. Reviewing changes in production processes for their environmental, health and safety impact	30%	76%
6. Allocating environmental costs to processes or products	21%	52%

*Total number of facilities = 434, Survey administered in June-July, 1996.
**Note: only "very involved" responses shown. Other responses were: somewhat involved and not at all involved.

TUR Project Implementation

The Toxics Use Reduction Act does not require that facilities implement toxics use reduction. Rather, a primary aim of the act is to motivate firms to implement TUR through systematic process evaluation and TUR option identification and assessment. Both the survey and the in-depth investigation provide strong evidence of TUR implementation at TURA firms.

When asked how many of the TUR projects *selected for implementation in their TUR plan* would be fully implemented, 81% of survey respondents (351 of 434 facilities) answered that they have or will implement at least a few of the projects. Only 9% of respondents (41 facilities) thought that none of the projects identified would actually be implemented and 42 respondents did not know.

Furthermore, the survey data show a clear connection between TUR implementation and reductions in byproduct generation/toxic chemical use. Survey respondents were asked if their facility's net byproduct generation and toxic chemical use (per unit of total production) had *increased, decreased* or *remained unchanged* since 1990. The survey researchers found the following:

Of the facilities that said they have or will implement at least a few of the projects identified in their TUR plans:

- 61% reported that they have *decreased* their byproduct generation since 1990, **and**
- 67% reported that they *reduced* their toxic chemical use during the same time frame.

Whereas, of the firms that have not implemented any of their identified TUR projects:

- 61% reported that byproduct generation has *increased or remained unchanged* since 1990, **and**
- 66% reported that toxics use has *increased or remained unchanged*, during the same time frame.

Therefore, it appears that TUR implementation has resulted in reductions in byproduct and use in a significant number of companies, and lack of implementation shows the opposite effect.

The in-depth investigation revealed that all 22 TURA firms studied had implemented one or more toxics use reduction changes between 1990 and 1996. These projects included product redesign, production process modifications, and improvements in operations and maintenance. The study found that the "intensity" of TUR efforts varied from firm-to-firm. Several firms had mounted aggressive TUR campaigns aimed at eliminating all TUR chemicals from their facilities; others had their sights set on more limited goals such as fine-tuning a single production process or reducing by-product of a single chemical. Three examples of toxics use reduction projects found in the in-depth investigation were:

- reduction in use of 23,000 lb/year of copper ammoniate solution at an electronics manufacturer by modification of a process
- elimination of 14,000 lb/year of highly concentrated (73%) sodium hydroxide powder in a food cleaning operation through substitution with a mild surfactant
- reduction in use of 2,000 lb/year of nitric acid through the installation of a nitric acid recovery system at a job shop metal finishing company.

Barriers to TUR Implementation

Twenty six percent of respondents to the survey of LQTUs indicated that they have or will implement all of the TUR projects that they selected for implementation in their 1994 plan, 29% said they have or will implement most, 27% said a few, and 9% said none (9% said they do not know). The survey sought to elucidate the reasons why some firms were not implementing all of their target projects. These respondents were asked which, if any, factors were barriers to implementation. The most important barrier was company concern with impact on product quality; 71% of respondents (198 of 434) said this was very or somewhat important. All responses are summarized in the figure below.

Figure 4 Barriers to TUR Project Implementation

Factor	*How important were each of the following factors in your company's decisions not to implement TUR projects?**		
	Very	*Somewhat*	*Not at all*
Capital not readily available	26%	26%	46%
Customers not accepting change in the product	31%	14%	51%
Lack of management support for changes	9%	20%	66%
Company concern with impact on product quality	51%	20%	27%
*Total number of facilities not implementing all projects = 281 Row totals may not equal 100% because of "Don't Know" or refusal responses.			

Small vs. Large Firms These responses did not vary significantly across facility size.

Industry Type The electrical and electronic equipment (SIC 36) and fabricated metal products (SIC 34) industries were the most likely to claim that capital availability was a barrier to TUR project implementation. In these two sectors, 64% and 63% of facilities, respectively reported lack of capital as "very important" or "somewhat important" to their decision not to implement all projects, compared to 48% for all other industries.

In contrast, primary metal (SIC 33) and paper and allied products (SIC 26) industries were less likely than other industries to say that availability of capital was a reason for not pursuing TUR projects; 63% of respondents from primary metal firms (15 out of 24) and 62% from paper and allied projects firms (13 out of 21) indicated that capital availability was not at all a factor. For all other industries, 43% reported that capital was "not at all" a barrier.

2.1.2 Did the TURA Agencies Implement the Law?

Answer: Since the inception of the TURA program, the TURA agencies have put in place numerous and varied programs and activities supporting toxics use reduction, involving members of Massachusetts industry and the general public. The agencies were charged with 55 mandates under the Toxics Use Reduction Act. An accounting shows that the agencies have fulfilled a total of 45 (or 82%) of these mandates. Ten of the 55 mandates (or 18%) have not yet been fulfilled. The agencies carried out 8 (or 57%) of the 14 discretionary tasks created by the law. These statistics show that the program agencies have fulfilled the majority of the numerous and complex mandates of the law.

The Toxics Use Reduction Act contained numerous mandates for the TURA program agencies. Appendix A contains the results of a detailed inventory and assessment of the tasks, programs, and activities undertaken by the agencies in fulfillment of these mandates. This section provides a summary of this inventory and assessment, organized by TURA agency.

Office of Technical Assistance for Toxics Use Reduction (OTA)

OTA was given six mandates under the Toxics Use Reduction Act. The Office was charged with delivering confidential technical assistance and compliance assistance to toxics users, large and small, assisting filers with reporting and coordinating their work with private sector initiatives. OTA fulfilled all mandates to date with the exception of one. Section 7 requires the office to "engage in an outreach program to small businesses required to report and plan as a result of prioritization..." Since user segments, and priority user segments, have not been designated by the program, OTA has not yet been called upon to fulfill this mandate. The Office does, however, make its services available to all small businesses.

Since its creation, the Office has conducted more than 1,400 site visits to more than 600 companies, both TURA filers and small quantity toxics users. These visits stem both from referrals by DEP and other regulatory agencies and in response to OTA's outreach efforts. Small quantity toxic users served by the Office include auto repair shops, dry cleaners, industrial laundries, hospitals, machine shops and lawn care providers. OTA has worked extensively with publicly-owned treatment works (POTWs), schools and research laboratories.

OTA is an active agent of toxics use reduction technology transfer. OTA has sponsored or co-sponsored approximately 200 conferences, workshops, clinics and other events targeted at toxics users and has played a role in approximately 200 more events sponsored by other organizations. The Office disseminates written information on its site visits and other projects through case studies, reports, and journal articles, including a regular column in Manufacturers' Mart[7].

[7] Manufacturers' Mart Publications, Manufacturer's Mart, Westerley, Rhode Island.

OTA has been very successful in receiving federal support for specific toxics use reduction projects, allowing the office to expand its work and audience. Since 1994, OTA, in collaboration with the state's Division of Energy Resources, has assisted three Massachusetts companies in winning a combined total of more than $1.2 million in federal grant funds through the National Industrial Competitiveness through Energy, Environment and Economics (NICE3) program. Appendix B presents a list of federal grants awarded to OTA.

Among the oldest technical assistance programs in the nation, OTA has been a pioneer in many technical assistance programs and outreach projects (the first-ever "Solvents Bazaar" for example) that have been used as models by other states. It has received national recognition for its work on a number of specific projects, and two staff members have been asked to serve on EPA national committees for the printing and electronics industries. In addition, the Office has responded to many requests for information about the Office from countries in Europe, the Far East and South America.

Toxics Use Reduction Institute (TURI)

TURA created 11 mandates and 2 discretionary tasks for the Toxics Use Reduction Institute. All mandates were fulfilled on schedule. Several notable accomplishments of the Institute are highlighted here.

The Institute's education and training programs have achieved international recognition. The Institute has recently completed its 27th Toxics Use Reduction Planner's Course. Currently offered twice a year, this 48 hour course provides attendees with the knowledge and skills necessary to develop a TUR plan as well as information on state-of-the art TUR technologies in industries critical to the Massachusetts economy. Course participants learn to do process characterization, materials accounting, and economic analysis of TUR options through instruction by experts from Massachusetts industry and through group projects. Copies of the course curriculum have been requested by organizations around the world.

The Institute operates a research and testing laboratory, the Surface Cleaning Lab, that evaluates the effectiveness of aqueous-based cleaning chemistries and equipment on a variety of substrates and soils. Services are available free-of-charge to Massachusetts industries seeking help with alternatives to toxic solvent-based cleaning systems. During fiscal year 1996, testing services were provided for 27 Massachusetts companies, representing a variety of industries including: metal finishing and fabrication, electronics, paper, precision instruments, biomedical and optics. Information assistance and one-day workshops were provided to many more companies.

Each year the Institute awards grants to Massachusetts companies willing to develop, pilot test or demonstrate innovative technologies. The Matching Grants/Cleaner Technology Demonstration Sites Program has disbursed a total of $350,000 since 1993 to 34 companies in Massachusetts to

engage in innovative TUR technology research or demonstrations. In fiscal year 1995, for example, the Institute awarded $50,000 for research in reduction and possible elimination of acetic acid use in disperse dying of textiles, cleaning alternatives for adhesives and coatings process reactors, design for the environment in the electronics industry, and aqueous degreasing for electronic components manufacturing. These funds were matched dollar-for-dollar by the firms. In fiscal year 1996, five Massachusetts companies opened their doors to 500 industry representatives and private citizens to demonstrate their innovative cleaner manufacturing technologies.

The Institute's Technology Transfer Center is a research library and clearinghouse for information on toxics use reduction and pollution prevention. In fiscal year 1996 alone, the center responded to 1043 requests for reference services or institute publications. Located at the University of Massachusetts Lowell, the center is a resource for Massachusetts industry, government, municipalities, citizens and the academic community. The center has a collection of more than 15,000 books, conference proceedings and technical papers; subscriptions to over 100 journals and newsletters; searchable computerized databases; CD ROM databases on chemical characteristics, chemical toxicities, regulations and the EPA's Toxic Release Inventory. The center created "P2Gems", an internet based tool designed to assist TUR Planners in finding information about emerging clean technologies and management tools.

The Institute has an active publication series that produces case studies, fact sheets, policy and technical reports. In addition, the Institute prepared and delivered to the legislature two reports on "further chemical restriction policies" as required under Section 6(J).

The Department of Environmental Protection (DEP)

TURA created 25 new mandates and 9 new discretionary tasks for the DEP. The Department was given responsibility for drafting numerous and complex regulations governing chemical use, byproduct and emissions reporting under TURA; establishing criteria for TUR plans and plan summaries; TUR planner certification rules and other key areas of TUR program implementation. The Department was also charged with collection and public accessability of TUR data, developing and implementing multi-media inspections, and reporting on TUR progress. Of the 25 mandates, DEP fulfilled 17 and has yet to complete 8 of the mandates under the Act.

Several mandates implemented by the department are notable. First, the Department has made progress in incorporating a multi-media focus into its regulatory programs through the institution of FIRST inspections. FIRST (Facility Wide Inspections to Reduce the Sources of Toxics) inspections are multi-media or whole-facility compliance inspections that simultaneously check for compliance with applicable environmental rules for air, industrial wastewater, hazardous waste, and TURA. One goal of the FIRST program is to identify TUR options and to promote

TUR to the facility as a sound management practice and preferred means of achieving environmental compliance. (Section 2.3.4 reports on the results of an assessment of the program in the in-depth investigation). The program was implemented across DEP in 1992 and has won national recognition and a Ford Foundation award for innovation in government.

The DEP has promulgated several regulations to provide guidance for the TURA program, annual Reporting Packages, a 1993 Planning Guidance manual, and a 1995 Plan Update Guidance document. All of these have been distributed widely among the TURA filers and each of them has received praise for their clarity and thoughtful assistance. In addition, the DEP prepares and releases an annual report summarizing the TURA data collected from the firms individual reports.

With the creation of its TURA World Wide Web home page, the Department has made TUR data accessible to the public via the internet.[8] Created in 1995, the TURA home page is accessed by 100 - 150 users per month. Users can retrieve TURA data extract files, slide show presentations of TURA data, a glossary of TURA terms, TURA chemical lists and other information.

The Department has received several federal grants to support its TUR efforts. These grants include: an EPA Pollution Pervention Incentive for States grant to develop software for analysis and reporting of TURA data; an EPA Demonstration Grant to develop and implement its FIRST inspection program; an Environmental Technology Inititiative (ETI) grant (with TURI) to develop pollution prevention and cross training within DEP; and an EPA grant to develop and implement consolidated reporting in all regulatory programs. In total, these grants have brought in over one million dollars to the Commonwealth for TUR regulatory activities.

The Department has not yet succeeded in consolidating all reporting on chemical use, release and disposal, as mandated in Section 3(B) of the Act. The Department is currently exploring several possibilities for achieving one-stop reporting, i.e., consolidating TURA reporting, source registration, annual industrial wastewater reports, RCRA biennial reports, etc., which would require EPA to grant the Department regulatory flexibility. Neither has the Department established an electronic system for filing TURA data, as mandated in Section 10(H).

The Department will soon promulgate regulations to create user segments (i.e., a set of toxics users who employ a similar production unit as classified by a pairing of industrial process and product) as mandated in Section 3(G) of the Act; promulgation is expected in the beginning of April of this year. The Department has developed the process code component of the user segment designations; filers have been required to report process codes on Form S reports since 1994.

---

[8] The DEP-TURA world wide web address is http://www.magnet.state.ma.us/dep/bwp/dhm/tura/.

Administrative Coordinating Council and Advisory Board

The Administrative Council and the Advisory Board were assigned 11 mandates and 3 discretionary tasks under TURA. Of 11 mandates, 7 were fulfilled on time, 3 have been initiated and are ongoing, and 1 unfulfilled mandate remains which deals with priority user segments.

As the coordinating body of the TURA program, the Administrative Council meets bimonthly to publicly discuss program activities, establish policy for the TURA program and make determinations on the list of substances regulated under TURA. In 1996, along with the Advisory Board on Toxic Use Reduction, the Council sponsored a "TURA Futures Day," a day-long forum where TURA stakeholders and program staff met to discuss the future of the TURA program and to identify key directions to guide the program's future activities. Since 1995, the Administrative Council has prepared and released an Annual Report on the TURA program's performance and future plans.

The Advisory Board has met periodically to provide advice and support to the implementing agencies and to nominate candidates for the annual Governor's Awards for outstanding achievement in toxics use reduction. In fiscal year 1996, on the recommendation of the Advisory Board, Governor William Weld presented the Governor's Toxics Use Reduction Award to three companies and the three TURA program agencies (OTA, TURI, and DEP). Among the accomplishments of the 16 proposals received that year were: 2.3 million pounds in reduced toxic chemical use, 5.7 million pounds in reduced toxic waste generation, and $4 million saved in reduced chemical purchases. A total of 14 Governor's Awards have been presented to Massachusetts businesses since the program's inception in 1994.

Additional documentation on the activities of the TURA program agencies carried out in fulfillment of TURA mandates can be found in the TURA Program Archive located at the Toxics Use Reduction Institute.

2.2 What happened to Toxic Chemical Use and Byproducts?

Answer: Massachusetts industries are making progress in toxics use reduction. Between 1990 and 1995 – the years for which TURA data exists – toxic byproduct generation declined by 30% and toxic chemical use dropped by 20%. These figures are normalized to take into account changes in levels of production. According to the survey, 55% of facilities decreased their byproduct generation and 60% decreased their use of toxic chemicals per unit of total production, since 1990.

2.2.1 A Look at 1990-1995

This section provides a broad view of progress in toxics use reduction using available TURA and federal Toxics Release Inventory (TRI) data. More detailed information can be found in two principal documents: The DEP's "1995 TURA Data Release," and TURI's report "Measuring Progress in Toxics Use Reduction and Pollution Prevention."[9]

TURA firms have been reporting TUR data since 1990. Data for the period 1990 through 1995 are currently available. Figures 5 and 6 present data on byproduct and total use for that period, respectively. Data from firms that claimed trade secret protection are excluded from these graphs. The graphs show actual byproduct and use as well as "expected" quantities of byproduct and use for "core industries and chemicals." The term core industries and chemicals is used to describe a subset of byproduct and use data reported by facilities falling into manufacturing SIC codes and including only those chemicals first reportable in 1990. This universe of facilities and chemicals comprises the largest consistent data set available for the years 1990 through 1995 and is used to assess trends over that time period. Expected byproduct and use are defined as the amount of byproduct or use that would be expected in a particular year had TUR not occurred. The text box titled "Data Trend Analysis Definitions" provides more detail on these terms.

TURA Definitions

Byproduct - all non-product outputs of a TURA reportable substance generated by a production unit prior to handling, transfer, treatment and release.

Total Chemical Use - the total amount of a TURA chemical reported as manufactured, processed, and otherwise used.

[9] The Massachusetts Department of Environmental Protection , Bureau of Waste Prevention, 1995 TURA Data Release; The Massachusetts Toxics Use Reduction Institute, "Measuring Progress in Toxics Use Reduction and Pollution Prevention," Technical Report No. 30, 1996.

Toxic Byproduct

Figure 5 shows that actual byproduct quantities have trended downward from 1990-1995 despite an upward trend in expected byproduct from 1992 to 1995. The actual percent change for this period was 19%. When adjusted for changes in production, the normalized percent change in byproduct was a 30% reduction. Again, this result excludes trade secret data.

Toxic Chemical Use

The toxic chemical use data tell a somewhat different story (Figure 6). Both actual and expected use appear to follow a downward trend between 1990-1992 and 1993, respectively; to rise in 1994 and decline again in 1995. However, the increasing difference between actual and expected values from 1991-1995 shows progress toward toxic chemical use reduction. Actual use from 1990-1995 went down by 8.2%, but when the effect of increased production is removed, the normalized percent change in use for that period was 20%.

Figure 5

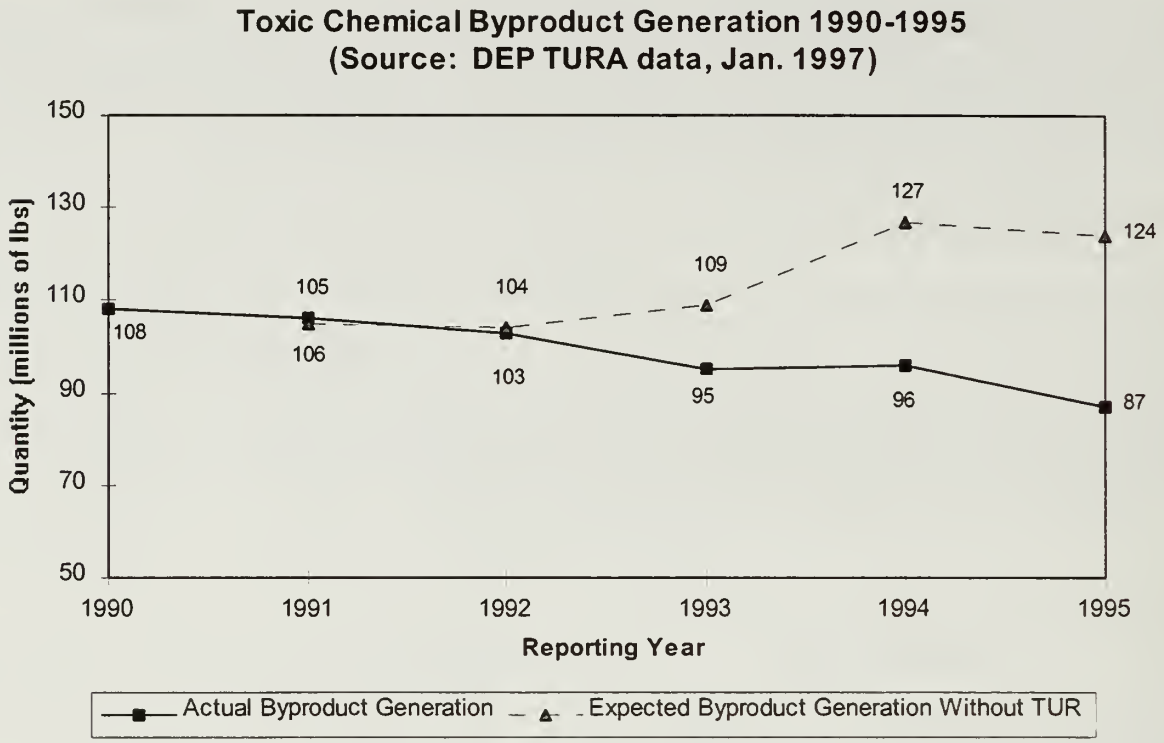
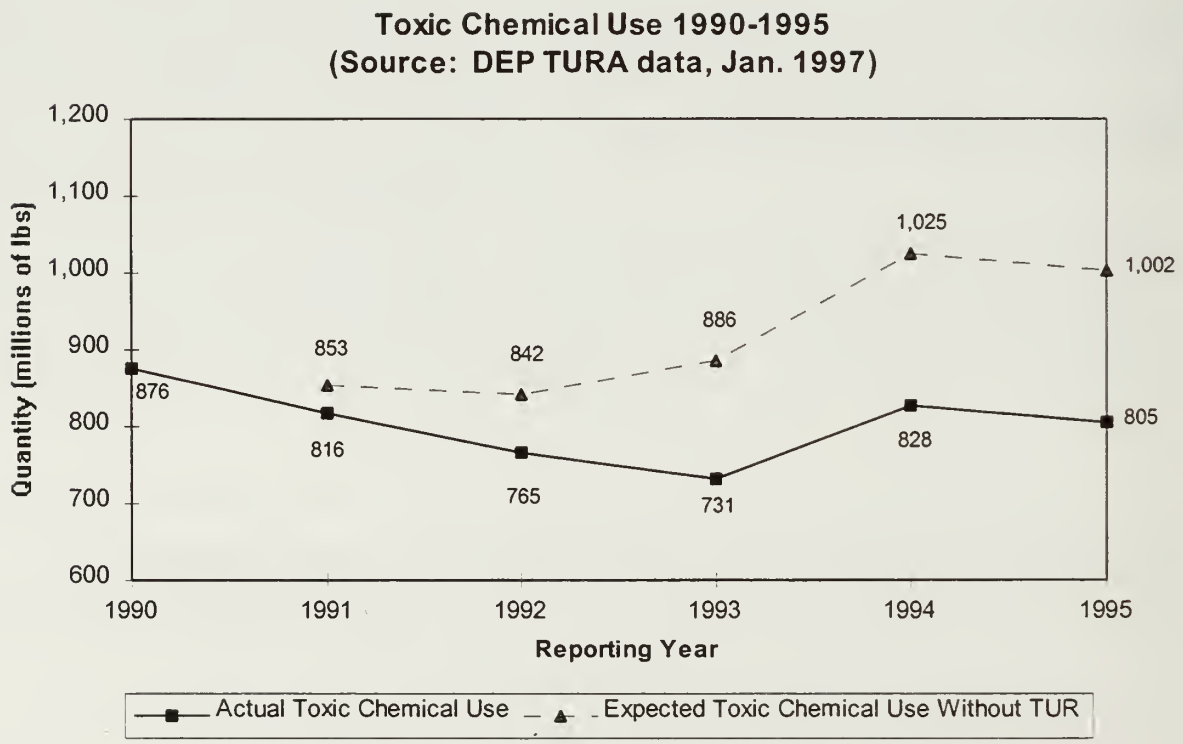


Figure 6



Data Trend Analysis Definitions

Actual Percent Change - The percent change in total reported quantities of chemical over a period of time. Observed changes in quantities may be due to either TUR or changes in levels of production.

Core - the TURA data set that includes facilities in manufacturing SIC codes and chemicals first reportable in 1990. Core facilities and chemicals include: (1) facilities whose SIC code is between 20 and 39, inclusive; and (2) facilities that manufacture, process, or otherwise use reportable quantities of 1990 EPCRA reportable chemicals. Chemicals delisted from the TURA chemical list between 1991-1995 have been excluded. These delisted chemicals include barium sulfate and metal alloys of copper, nickel, chromium, cobalt and manganese.

Expected Use and Byproduct - An estimated quantity of chemical use/byproduct that would be expected in a year had TUR not occurred. The expected quantity is directly proportional to year-to-year changes in production only. Thus, the difference between the expected and actual quantities in a given year is the change attributable to TUR. These values are calculated as follows:

Expected Qty. Yr. 2 = Expected Qty. Yr. 1 x TRI Production Ratio Year 1 to 2

TRI production ratio, reported in the Form R, is used to estimate the change in production levels from one year to the next. The production ratio is:

$$\text{TRI Production Ratio} = \frac{\text{Production in year 2}}{\text{Production in year 1}}$$

When the production ratio is greater than one, it means that production increased in year 2 compared to year 1, and vice versa.

Normalized Percent Change - A metric that reflects progress resulting from TUR. It is the difference between the expected quantity without TUR and actual quantity reported, expressed as a percent. For example: If Company A doubled their level of production from 1990 to 1995, but their byproduct remained constant, then their actual byproduct change would be 0%, but their normalized percent change in byproduct would be 50%.

2.2.2 Will Massachusetts Achieve the Goal of 50% Byproduct Reduction Between 1987 and 1997?

Answer: It is not yet possible to determine whether this goal will be reached since TURA waste or byproduct data are only available from 1990 to 1995 and since the efforts to estimate the 1987 baseline are inconclusive.

The first policy goal of the Toxics Use Reduction Act of 1989 establishes for the Commonwealth a statewide goal of 50% reduction in toxic waste by the year 1997 through toxics use reduction. Section 13(A) of the Act refines the goal by setting 1987 as the base year. A 1987 base year was chosen to recognize progress made by industries prior to the passage of the Act. Since TUR data collection began only in 1990, evaluating progress toward the 50% goal is problematic.[10] This part of the report presents the results of an effort, undertaken by DEP, to estimate byproduct generation in 1987 in order to gage progress toward goal 1 of the Act.[11]

The methodology used by DEP to estimate byproduct generation in 1987 centered on a voluntary survey of a subset of TURA firms that filed in 1990. The survey was designed to gather data that would enable DEP to approximate the quantity of byproduct that these firms would have reported in 1987 had the reporting requirement existed at that time. Of 678 facilities that reported in 1990, 188 facilities were contacted to obtain data for the 1987 baseline – the "Top 20" chemical users in 1990 and 168 other TURA firms. Of those, 160 responded to general questions about changes in production and TUR efforts between 1987 and 1990. A smaller number, 103 core facilities, responded to more detailed questions about how byproduct changed for specific chemicals during that time frame (see Section 2.2.1 for definition of core facilities). Although surveyed, none of the 1990 "Top 20" TURA chemical users supplied byproduct data, only general information on changes in levels of production from 1987 to 1990 (one of the Top 20 companies has closed). These Top 20 users constituted 73% of chemical use in 1990.

The analysis of the survey data yielded an approximation of the amount of byproduct that would have been reported in Massachusetts, in 1987. That amount is negligibly different, i.e., less than 1% higher, than the amount of byproduct reported in 1990. Furthermore, based on estimates provided by the 103 core facilities, production levels in 1987 were 3% lower than in 1990. The study concluded that the 1987 baseline is very difficult to estimate and that the byproduct figure for 1990 is a good approximation of 1987 byproduct.

---

[10] It is not possible to derive a 1987 baseline directly from 1987 TRI data since TRI releases and transfers are not equivalent to TURA byproduct, as defined by the Toxics Use Reduction Act.

[11] Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, "1996 TURA Baseline Report," March, 1997.

Since this result is based on estimates of 1987 byproduct generation, from 103 core facilities, it comes with several important caveats. First, most firms surveyed did not have the capacity to provide precise figures on 1987 byproduct quantities because of insufficient documentation and/or changes in personnel. The estimates provided by firms are fairly rough. Second, since none of the Top 20 companies (that used 73% of reportable chemicals in 1990) supplied byproduct data, this estimate does not take into account their performance between 1987 and 1990. Anecdotal information from several larger TURA firms suggests that progress in toxics use reduction was being made during that time. Unfortunately, the lack of data from these firms makes quantification of these changes in byproduct impossible.

Is this result consistent with trends seen in the Massachusetts federal TRI data? The answer to this question is also not clear. The TRI data for reporting years 1988 to 1994 reveal a steady downward trend in *total toxics releases to the environment* during that period. (Although EPA began collecting the data in 1987, reporting was phased-in over several years and the Agency considers data for that year highly unreliable. Data for reporting year 1995 are not yet available.) This trend appears to contradict the findings of DEP's 1987 baseline study. However, TURA byproduct and TRI emissions are not comparable quantities. TURA byproduct represents all production-related wastes of listed chemicals, measured upstream of pollution control devices. TRI releases are emissions directly to the environment measured downstream of pollution control devices. Reductions in TRI releases from 1988 to 1990 might have been caused by improvements in pollution control efficiency or prevention; it is not possible to know. Byproduct and TRI releases do not necessarily track. Therefore, TRI releases are not a good proxy for estimating TURA byproduct levels in 1987.[12]

With a normalized figure of 30% reduction in state-wide byproduct generation (from the core industries and chemicals) occurring from 1990 to 1995 and a high degree of uncertainty about changes in byproduct between 1987 and 1990, it is difficult to determine how closely the TURA program is meeting the 50% waste reduction goal. The five years represented by the 1990 to 1995 data *should* produce 25% byproduct reduction (one half of the desired reduction if the trend were assumed to be a steady decline over the ten year period 1987 to 1997), and instead it produced 30%. This would suggest confidence in meeting the 50% goal. But the uncertain findings from the period 1987 to 1990 appear to suggest that the 50% reduction may need to occur over only the last seven of the ten years. This would mean that the data from years 1996 and 1997 will need to demonstrate significant reductions in order to meet the statewide goal.

[12] The quantity "total production-related waste" – reported on the federal SARA 313 (Toxics Release Inventory) form R, Section 8 – would be a reasonable proxy for TURA byproduct quantities. However, EPA began collecting this data only in 1991.

2.3 How Valuable are the TURA Program Elements and Resources?

Answer: The most frequently reported benefits from implementing TUR projects were cost savings (67% of respondents) and improvements in worker health and safety (66%). Seventy percent, or 302 of 434 survey respondents indicated that they had identified TUR opportunities *as the result of* their 1994 plan. Of the 21 firms in the in-depth investigation that had conducted TUR planning, 11 stated that planning was a major factor in driving them to consider and implement TUR. Four firms stated that planning was important but not a major factor and six firms failed to implement TUR through planning. Of the six that had not implemented TUR, three indicated that they did not believe *a priori* that planning would be productive and devoted few resources to it. Of 22 TURA firms interviewed, six stated that Form S reporting provided benefits for their operations including better information about materials in products, processes and waste streams as well as providing a priority list of chemicals for TUR efforts. Twelve of 22 respondents reported that the collection of Form S data provided no benefit to their operations. In the survey TURA program resources were found to be "very" or "somewhat" useful in implementing toxics use reduction by almost all of the respondents that have had exposure to them. Toxics use reduction planner training and OTA site visits were regarded as the most useful TURA agency resources.

2.3.1 TUR Implementation

This section focuses on *the value of TUR implementation to those firms that implemented TUR.* The benefits of TUR to workers, the public and the environment will be discussed in Section 2.4.

Survey respondents that had reported implementing TUR projects as a result of their 1994 plan (351 out of 434 total survey respondents) were asked if TUR project implementation brought benefit to several areas of business operations that contribute to the competitive position of a firm. Figure 7 summarizes the results. Respondents were permitted to offer additional benefits other than those presented in the survey question; these responses were recorded and categorized. Thirty percent of survey respondents chose to provide and rate additional benefits. Those responses are summarized in Figure 8.

The most frequently reported benefits from implementing TUR projects were cost savings and worker health and safety improvements. A total of sixty seven percent of respondents claimed that they actually saw direct cost savings (e.g., on materials use or waste disposal) and 66% reported that they realized improvements in worker health and safety. While a smaller number of respondents reported reduced regulatory compliance requirements (45%), improved environmental image (38%) and marketing advantage (27%), these numbers are not insignificant considering that these benefits can be of great value to the companies that achieve them.

Approximately 30% of facilities (105 of 351) reported additional benefits. Of these additional responses, 58% (61 respondents) said that TUR project implementation improved management or employee awareness about TUR-related issues.

Figure 7 Benefits from TUR Project Implementation

Benefit	*% of Respondents that "actually saw" benefit to:**		
	A great extent	*Somewhat*	*Not at all*
Cost savings	17%	50%	31%
Improved worker health and safety	21%	45%	31%
Reduced regulatory compliance requirements	11%	34%	52%
Improved environmental image	11%	27%	59%
Other benefit provided by respondent	15%	15%	-
Marketing advantage	7%	20%	72%
*Total facilities = 351 facilities that reported implementing TUR as a result of their 1994 plans; Rows may not add to 100% because refusals and "Don't Know" responses are not presented			

Figure 8 Other Benefits from Implementing TUR Projects, Provided by Respondents

Benefit	*Number of Respondents that "actually saw" benefit**
Improved management or employee awareness of TUR-related issues	61
Reduced emissions	14
Improved materials accounting	12
Improved product quality	8
Beneficial effects on suppliers or customers	5
Other benefits	5
*Total number of facilities = 105	

When asked which benefit indicated "was most valuable to" their company, 32% answered cost savings and 29% said improved worker health and safety (194 facilities responded to this question). All other responses (i.e., those from Figure 7 and 8) rated between 3 and 13%.

Small vs. Large Firms The survey revealed that small facilities were less likely than large facilities to see cost savings as the result of implementing TUR projects. Twenty eight percent of respondents from facilities with 50 or more employees answered that they *did not* see cost savings at all, compared to 41% of respondents from firms with 50 or less employees. Other benefit categories did not vary by firm size.

Industry Type The rubber and miscellaneous plastics products (SIC 30), electrical and electronic equipment (SIC 36) and fabricated metal products (SIC 34) industries were more likely than other respondents to see cost savings "to a greater extent", as shown in Figure 9.

The electrical and electronic equipment (SIC 36) and paper and allied products (SIC 26) industries were most likely to say TUR projects improved their environmental image. Fifty two percent (32 of 61) of facilities in these industries said TURA actually improved their image somewhat or a great extent. All other industries averaged 34% (99 of 290).

Figure 9 Association of SIC Code with Extent to Which Companies Saw Cost Savings

Industry	*To What Extent Did Your Company Actually See Cost Savings...*			
	A Great Extent	*Somewhat*	*Not At All*	*Number of Facilities**
Rubber and Miscellaneous Plastics Products (SIC 30)	29%	43%	25%	28
Electrical and Electronic Equipment (SIC 36)	28%	58%	14%	36
Fabricated Metal Products (SIC 34)	23%	52%	23%	71
All Other Industries	12%	49%	38%	216
Total number of facilities = 351				

Financial Return on TUR Investments

Toxics use reduction projects are voluntarily undertaken by TURA firms for a number of reasons. Financial return can be a compelling motivation for TUR implementation, but as the survey results of Figure 8 indicate, it may not be chief among motivations for many firms. Nevertheless, in assessing whether toxics use reduction is enhancing the competitiveness of Massachusetts industries, the financial return on investments in TUR projects is an important consideration.

In the in-depth investigation, extensive financial data was collected on the TUR projects undertaken by 12 of 21 firms stating that they implemented TUR projects *as a result of preparing their TUR plan.* The number of projects implemented by the 12 companies ranged

from one to many; 3 of 12 companies invested capital in their projects while 9 did not. For a total of $208,206 of investment in capital, plant and equipment, $1,513,420 of net savings were generated (in 1995 dollars, assuming a ten year project lifetime). Based on this data, *the ratio of net savings to capital investment for TUR projects implemented is roughly 7 to 1 for these 12 firms*. This analysis does not include tax or depreciation effects, personnel costs for project planning and implementation, nor difficult-to-quantify benefits such as improved worker health and safety, however it does offer a picture of the significant financial return of TUR projects.

2.3.2 Planning

The TUR planning process is intended to be a continuous process that guides firms in identifying more efficient production methods that will both prevent pollution and save money. The process is designed to be flexible, leaving companies free to use the process or format that is most useful and efficient, though all plans are required to contain specific elements (e.g., a management policy, process characterization, and TUR options identification). The first round of TUR plans were prepared by TURA firms by July of 1994. Plan updates are done biannually.

Identification of TUR opportunities is the primary goal of TUR planning and seventy percent (302 of 434) of survey respondents indicated that they had identified TUR opportunities *as the result of* their 1994 plan (25% said that no opportunities had been identified and 5% did not know). The in-depth investigation found planning to be a strong force in motivating TUR: 11 of 21 firms that prepared plans stated that planning was a major factor in driving them to consider and implement TUR. Four firms stated that planning was important but not a major factor. For these firms, TUR planning provided additional information to management, focused TUR efforts or improved the quality of projects that the company had already planned to implement. Six firms failed to implement TUR through planning. Three of the six indicated that they did not believe *a priori* that planning would be productive and devoted few resources to it.

> Small vs. Large Firms Survey respondents from small firms were less likely than respondents from large firms to identify opportunities for toxics use reduction as the result of the planning process. Fifty percent of respondents from firms with less than 50 employees (63 of 111) identified TUR opportunities as a result of TUR planning, whereas 74% (239 of 323) of larger facilities did so.

In the in-depth investigation, firms were asked to describe the qualitative benefits that were derived from TUR planning. Figure 10 summarizes the responses provided by 21 TURA firms. TUR Planning case studies for two firms are presented in Appendix C.

Several qualitative plan benefits are notable. Eight firms studied made TUR changes that resulted in significant worker health and safety improvements, even though in some cases the net present value (NPV, a reflection of financial profitability) was negative. Two firms used the process characterization component of the plan to comply with the federal Clean Air Act risk management requirements and the OSHA process safety requirements. While preparing their

TUR plan, a metal heat treater realized that several furnaces had poor control of ammonia levels (ammonia is a process gas that controls the metal hardening process). Inadequate control wasted ammonia and led to great variations in product quality. By installing flow control valves – a TUR option included in their plan – product quality became more uniform and thus significantly lowered cost by reducing rework and scrap. Another company, while planning a move to a new facility in 1995, used detailed information on water and chemical use and product flow from their TUR plan to design the new plant and purchase new process and treatment equipment.

Figure 10 Qualitative Benefits of Planning Reported in the In-Depth Investigation

Benefit of Planning	*Number of Firms Reporting*
Improved workplace health and safety	8
A focus for environmental projects	7
Decreased regulatory burden	5
Improved business decision making	4
Improved process knowledge	4
Improved regulatory compliance	3
Improved product quality	2
Total number of facilities = 21, some firms reported multiple benefits	

Planning Components

Looking at specific components of the planning process, respondents to the survey found *materials accounting* and *development of TUR options* to be the most valuable components of TUR planning. The *cost of toxics calculation, financial evaluation of TUR options,* and *development of byproduct reduction goals* were considered least valuable. The results of this portion of the survey are presented in Figure 11.

Small vs. Large Firms Small facilities found materials accounting to be the most valuable component by a wider margin than larger facilities. Forty two percent (47 out of 111) of respondents from facilities with 50 or fewer employees said that materials accounting was most valuable.

Industry Type Forty nine percent of respondents in the chemicals and allied products (SIC 28) industry indicated that materials accounting was the most valuable part of the planning process, as compared to 26% of respondents from other industries.

Figure 11 Value of TUR Planning Components

Process component	*% of Respondents who chose process component as **most** valuable**	*% of Respondents who chose process component as **least** valuable**
Materials accounting (of toxic chemical use and byproduct generation)	30%	12%
The development of TUR options	22%	10%
The development of byproduct reduction goals	16%	24%
The cost of toxics calculation	11%	23%
The financial evaluation of TUR options	9%	18%
Don't know/Refused	12%	13%
*Total responses = 434		

The Value of Planning

By increasing awareness around toxic chemical use and waste generation, TUR planning is expected to elevate good chemical and environmental management practices within planning firms. When asked about the extent to which the TUR planning process had contributed to the adoption of TUR practices at their facility, firms reported impressive results as presented in Figure 12. Note that only those respondents that indicated that they had found TUR opportunities as a result of TUR planning (302 out of 434) were asked this question.

Figure 12 Contribution of the TUR Planning Process to TUR Practices

TUR Practice	*% responding* that planning process itself contributed to [practice]*		
	To a great extent	*Somewhat*	*Not at all*
Management attention to environmental practices	38%	50%	12%
Improvements in materials management	25%	55%	20%
Allocating environmental costs to processes or products	22%	54%	23%
Implementation of toxics use reduction	33%	56%	11%
* Total number of respondents = 302			

Costs incurred by TURA firms for planning were estimated both in the benefit-cost analysis and the in-depth investigation. Estimates from the former were an average of $9,782 for the 1994 plan and $5,714 for plan updates (in 1995 dollars, based on cost data from 206 survey responses). Approximately 80% of these costs are incurred by in-house staff and the remainder are consultant costs. The in-depth investigation estimated costs of $8,809 for the 1994 plan and $4,502 for the 1996 plan update, based upon 18 firms.

The in-depth investigation went a step further and calculated a Net Present Value for the firm's 1994 plans by adding the costs of the plan to the costs of implementing the TUR projects identified in the planning process and the net changes in operating costs stemming from these projects. Using data from the 21 firms that prepared plans, the NPVs of the plans ranged from one very high figure of $359,284 in savings to a low of $14,785 in costs. The total NPV for the 21 firms was $720,283 and the average was $34,299.

Finally, the survey posed the question *"If the planning requirement were removed would you continue to plan?"* Eighty-six percent of all respondents (375 of 434 facilities) said that if the TUR planning requirement were removed, they would continue to plan; 12% (50 respondents) said they would no longer plan and 2% (9) were unsure. Ninety two percent of respondents that had implemented all of the TUR projects that were identified in their 1994 TUR plan said they would continue to plan, while 56% of respondents that had not implemented any of their self-identified projects said they would plan. These responses indicate a serious depth of commitment to TUR planning, particularly among firms that were able to implement TUR projects from their plans. Even a majority of firms that did not implement TUR projects identified through planning said they would continue planning, suggesting that these firms are deriving benefits from planning beyond just TUR project implementation.

2.3.3 Reporting

The chemical use and byproduct data supplied by firms in TURA Form S reports supplement the chemical release and transfer data reported in the federal Form R. Together, Form S and R data create a comprehensive picture of the utilization and ultimate fate of toxic chemicals used by the subset of Massachusetts firms covered by TURA. The collection and reporting of toxic chemical use, byproduct, release and transfer are intended to serve two primary purposes. First, the collection of chemical data by the firm is expected to motivate toxics use reduction as well as lead to better targeting, implementation and tracking of toxics use reduction activities. Second, the public can utilize the data to track progress in toxics use reduction and to target resources such as technical assistance and research. This section examines the value of reporting from the perspective of the firm and the public.

The Value of Reporting to the Firm

In the in-depth investigation, firms were asked "what benefits (if any) has your company received as a result of collecting data for the Form S?". Of 22 TURA firms interviewed, six stated that Form S reporting provided benefits for their operations including:

- better information on materials in products, in processes and in waste streams
- a priority list of chemicals for TUR efforts
- a better understanding of the flow of materials through their production process
- the use of the byproduct reduction index (BRI) as a management tool for TUR planning

Twelve of 22 respondents reported that the collection of Form S data provided no benefit to their operations; 2 respondents did not know or were unable to answer the question.

Both the benefit-cost analysis and the in-depth investigation analyzed the costs of reporting to TURA firms. The benefit-cost analysis found that, on average, preparation of a facility's first Form S costs $3,004 and requires an average of 41 hours of labor (19 management, 18 technical and 4 clerical); subsequent Form S submissions cost on average $1,708. Roughly 90% of Form S preparation costs are incurred by in-house staff.

The in-depth investigation found that the majority of firms studied did not find TURA Form S reporting significantly burdensome. The average cost per chemical ranged from $366 to $596 (based on the same methodology as used in the benefit-cost analysis). Only three firms reported that TURA filing was very burdensome. One of three firms manufactures extremely varied and complex products. The remaining two report on numerous CERCLA chemicals, requiring them to prepare the federal Form R for submission to the state for these chemicals even though they are not required to do so by EPA.

The Value of Reporting to the Public

TURA requires that the Form S data submitted to the DEP by each of the reporting firms be made available to the public. The first data were publically released in 1993 in a set of computer generated reports. Beginning in 1994 the data have been made available by the DEP through computer "extract files" that require some skill to download and analyze and this past year these files have been loaded onto the DEP internet site to improve public access.

The data have proved to be of significant value to the agencies implementing the law. The OTA staff has used the data to better target their outreach and technical services and to inform their regional priority setting. TURI staff has used the data in generating research reports and in targeting specific industries and chemicals for grants or laboratory services. For instance, the 1993 data analysis led TURI staff to more directly focus on the plastics industry because styrene proved to be the largest volume toxic chemical used among the LQTUs. This resulted in a report on styrene and more work with plastics firms. The Science Advisory Board regularly reviews the

data in determining petitions for delisting chemicals from the TURA list. In collecting the data, DEP staff have used the data to seek verification and corrections in federal TRI Form R reports. The DEP has become increasingly effective at providing an annual release of data-based reports to the public that reveal trends in program performance. The department also integrates the TURA data into its comprehensive Facilities Master File to assist inspectors in conducting facility inspections and enforcing regulatory compliance.

General public use of the data has been less noteworthy as a result of some of the earlier difficulties in accessing the data. Still various non-governmental organizations have demonstrated sophisticated uses of the data. The Environmental League of Massachusetts, the National Environmental Law Center, Massachusetts PIRG, the John Snow Institute, and the Massachusetts Campaign to Clean Up Hazardous Waste have all published public reports that have used and analyzed the data, often to assess the performance of the TURA program or the progress of specific firms. The news media has typically relied on the DEP's annual release of reports rather than directly accessing the data for news stories. The data offers opportunities for other uses, such as emergency response planning, local community advocacy, educational programs and academic research.

2.3.4 TURA Program Resources

Survey respondents were asked whether they had used specific TURA program resources and then asked about the usefulness of the resources in implementing toxics use reduction. Figure 13 presents the results.

Toxics use reduction conferences and workshops were the most highly used TURA resource; 77% of respondents reported attending such events. Toxics use reduction planner training (67%) and assistance from the Department of Environmental Protection (65%) ranked next in use. While 44% of respondents reported having site visits from the Office of Technical Assistance, it should be noted that approximately half of OTA site visits are conducted at small quantity toxics user firms, and these firms were not included in the survey population.

Figure 13 Experience With and Opinion Of TURA Program Resources

ITEM	A. Experience?		B. Useful?			
	Yes	No	Very	Some-what	Not at all	Number of facilities responding
Toxics Use Reduction conferences and workshops	77.0%	22.8%	38.8%	48.2%	13.5%	334
Toxics Use Reduction Planner Training	67.3%	32.3%	45.5%	39.0%	13.0%	292
Assistance from the Department of Environmental Protection (DEP)	64.5%	35.3%	33.6%	52.9%	12.1%	280
Getting Toxics Use Reduction information from industry trade associations	53.7%	45.2%	27%	65.2%	6.9%	233
Toxics Use Reduction Institute (TURI) information services or library	53.0%	45.9%	31.2%	52.8%	15.1%	199
Site visits from the Office of Technical Assistance (OTA)	43.8%	56.0%	42.1%	44.2%	12.6%	190
Facilities responding: 434						

Technical Assistance

The in-depth investigation found that technical assistance services provided by the Office of Technical Assistance were valued by the firms that received them; all firms that received these services stated that technical assistance either met or exceeded their expectations.

Of the 25 firms studied in the investigation, 11 received TUR technical assistance from the Office of Technical Assistance in the form of on-site reviews of their industrial operations; 7 of the 11 received environmental compliance assistance as well. The outcome of technical assistance in the 11 firms that received one or more site visits from OTA was reported in the investigation:

- 4 implemented some or all of the recommendations
- 3 are in the process of testing the recommendations
- 2 tested but did not implement the recommendations
- 1 received guidance on how to prepare a TUR plan
- 1 did not test nor implement recommendations

and futhermore,

- 7 received compliance assistance with TURA and other regulatory requirements

Recommendations from OTA were numerous – a total of 24 for 11 facilities – and varied, including:

- methods to close-loop a pre-painting phosphating line
- techniques to reduce use and emissions of zinc and glycol ethers
- phosphoric acid recycling
- improvements in painting transfer efficiency and clean up operations
- strategies to improve inventory management to reduce waste generated by out-dated raw materials

Compliance assistance topics included:

- TUR plan preparation
- federal Clean Air Act operating permit requirements
- federal Resource Conservation and Recovery Act (RCRA) waste storage requirements

In three of the seven firms receiving compliance assistance from OTA, compliance assistance turned into an opportunity to implement TUR rather than end-of-pipe controls to meet a regulatory requirement. For example, one company that was out of compliance with a local sewer authority's discharge standard used OTA assistance in developing a new compliance schedule that enabled the firm to test and implement a TUR technique rather than install treatment technology.

All of the eleven respondents interviewed stated that TUR research and site visit reports were completed in adequate depth and detail and assistance was delivered in a timely fashion. Four respondents provided criticisms of technical assistance services. Two respondents stated that technical recommendations were not adequately evaluated; recommendations at these two firms did not work when tested at their site. One firm thought that technical assistance providers did not have sufficient knowledge about their process. A respondent from a large defense contractor stated that OTA was not able to suggest TUR options that the firm had not already considered.

Education and Training

The in-depth investigation concluded that the Toxics Use Reduction Planner's Course, offered by the Toxics Use Reduction Institute, contributed signficantly to the quality of TUR plans. Furthermore, the results of the study suggested that plans were a stronger motivator for TUR implementation when certified by a planner that took the TUR Planner course then when certified by a respondent that did not take the course.

Eleven respondents who had taken the Toxics Use Reduction Planner's were asked about their experience with the course. Ten out of 11 respondents stated that the course had a significant

effect on how they prepared their TUR plans, assisting in production process characterization, cost analysis, and providing tools for involving employees in the planning process. Respondents emphasized that the course benefitted them by introducing new TUR technologies and new skills to analyze production processes as well as creating a network of TUR professionals. Nine of 11 respondents were pleased with the course content; a masters-level engineer thought it was too simplistic and a nurse thought it too difficult. Several suggestions for improving the TUR planner course emerged from the in-depth investigation. Two respondents thought the course should be reorganized to follow the flow of the TUR planning process. One thought the course should be condensed.

The in-depth investigation found that respondents were, on the whole, satisfied with the 30 hour TUR planning continuing education requirement. Specific events mentioned as worthwhile were: the two-day conference held in 1995, internet training, and TURI's surface cleaning workshops. Networking was cited here too as a valuable benefit of the continuing education program. Three respondents, however, thought the continuing education offerings were "stale". No specific suggestions were offered by these respondents.

Regulatory Enforcement and Compliance Assistance

The in-depth investigation found that on the whole, TUR regulatory services met the expectations of respondents. Guidance documents developed to assist with Form S reports and TUR plans provided sufficient information. Nearly all interviewees in the study had called the DEP TURA Program office and were satisfied with telephone assistance provided – staff were both responsive and knowledgeable.

The in-depth investigation found that opinions of DEP's multimedia inspection program were mixed. Sixteen of the 25 firms studied in the in-depth investigation had received multimedia inspections. Half of these 16 firms approved of multimedia inspections primarily because multiple inspections could be accomplished in one visit. However, the other half reported that multimedia inspectors were inadequately trained in all media and that the inspections were "easier to get through." TUR strategies were recommended in a minority of these inspections. Only 4 of the 16 respondents recalled compliance inspectors recommending TUR – one in a notice of non-compliance (NON) and three during the inpsection itself. Where TUR was recommended, results were fairly impressive. The NON required that the company improve VOC control by placing covers on solvents while not in use. Two out of the other three firms receiving TUR recommendations implemented them. In one case, the firm eliminated mineral spirits and methylene chloride parts washers on the recommendation of the inspector. In the second case, the recommendation led the firm to implement improved housekeeping and other TUR options in the firm's painting operation.

Only five of the 16 respondents reported that their TUR plans were reviewed during multimedia inspections. In one case, the inspector was dissatisfied with a part of the plan and suggested areas needing improvement. In four cases the inspector did not comment on the plan, though during the in-depth investigation one of these plans was found to be lacking several whole sections. (The plan was certified by a general practice planner employed by one of the company's suppliers.) No TURA enforcement actions resulted from these inspections.

2.4 What are the Benefits and Costs of the TURA Program?

Answer: A study of the the benefits and costs of TURA concluded that the benefits of TURA to the Commonwealth exceed the costs of TURA for the period 1990 to 1997. This conclusion was reached purely on the basis of monetized costs and benefits as reported by TURA firms and is exclusive of the non-monetized human health and ecological benefits of the Act. The report identified total costs of $77 million and total *monetized* benefits of $91 million. The monetized benefits should be considered only a partial picture of the benefits of the TURA program because the value associated with the human health and ecological benefits of the Act, benefits to non-TURA firms, as well as other benefits, were not monetized.

In an analysis of the benefits and costs of TURA, Abt Associates compared the costs and benefits of the TURA program to the Commonwealth for the period 1990 through 1997. The study considered both costs and benefits accruing directly to TURA firms (i.e., private or internal costs and benefits) and benefits accruing to other members of the Commonwealth (i.e., public benefits).

The costs and benefits of TURA, for the period for 1990 through 1997, are presented in Figure 14. Monetized values are in constant 1995 dollars (i.e., adjusted to account for inflation) . Because the costs and benefits occur in different time periods, they were discounted to a present value before comparison to determine overall net benefits. A present value can be calculated for any base year; for the analysis 1995 was chosen. A real discount rate of seven percent was applied, which is the rate recommended by the federal Office of Management and Budget for analysis of federal regulations.

2.4.1 Costs of TURA

Compliance Costs

Figure 15 summarizes the costs of the Act, by cost category. The estimated cost associated with Form S filing and TUR plan preparation were built from three components: 1) the number of

labor hours required of managerial, technical, and clerical personnel, 2) the hourly wage rates for each type of personnel, and 3) external consulting fees. Cost data for these activities were gathered from the fax portion of survey, as described in Section 1.3.5. For Form S filing costs, the survey distinguished between initial and subsequent submissions; for planning, the preparation costs of the 1994 plan and 1996 plan update were also estimated separately. The category "other TURA fees" includes: DEP Toxics Use Reduction Planner certification and recertification costs, TUR Planner course fees, and TUR Planner continuing education fees.

Costs of Implementing TUR

TUR projects may or may not require capital investments. Firms may achieve significant reductions in toxic chemical use or byproduct generation through changes in operations and maintenance practices or chemical substitution without incurring capital expenses. Where capital expenditures were required for TUR implementation between 1990 and 1997, they were treated as a cost of implementing the Toxics Use Reduction Act. *Unlike investments in end-of-pipe pollution control, however, these investments become part of the productive capital stock of Massachusetts firms and contribute to the overall efficiency and modernization of the Commonwealth's industries.* Capital costs were estimated from data supplied by TURA firms in the Abt survey. Firms were asked to estimate capital expenditures "incurred to implement all projects identified as a result of TURA activities for the years 1990 through 1997."

2.4.2 Benefits of TURA

Reductions in toxics use, byproduct and emissions often benefit industry directly by decreasing operating costs. Because TURA does not *require* that facilities implement toxics use reduction projects TUR projects motivated by TURA are voluntarily undertaken by facilities, generally on the expectation of net financial benefits. For example, a facility may investigate, identify, and implement a solvent reduction opportunity and, as a result, save money on future purchases of solvent. Still some toxic use reduction techniques may result in increased operating costs. For example, a facility may substitute a more expensive, less toxic chemical for a currently-used chemical. Because changes in operating procedures credited to TURA typically result in a net cost savings, they are treated as benefits. Figure 16 presents the results of the analysis of net changes in operating costs, resulting from TURA activities, from the benefit-cost study. Net changes in operating costs were estimated from data supplied by TURA firms in the Abt survey. Firms were asked to estimate changes in operating costs "due to all projects implemented as a result of TURA activities" for the years 1990 through 1997.

Figure 14 Monetized and Non-monetized Costs and Benefits of TURA

(1990 through 1997 - millions of 1995 dollars)

Costs			Benefits	
Monetized				
Compliance Costs: -Form S preparation -TUR plan preparation -Form S filing fees -Other TURA fees (TUR planner training, continuing education, certification)	 $ 9.9 $ 10.1 $ 29.1 $ 0.3		Savings in operating costs (=net operating cost changes) Federal grants to TURA program for TUR activities in Massachusetts	$ 88.2 $ 2.3
Subtotal		$ 49.4		
Capital investments	$ 27.1	$ 27.1		
Total monetized TURA costs		$ 76.6	**Total monetized TURA benefits**	$ 90.5
Non-Monetized				
			Human health and ecological benefits from: -reduced worker health and safety risks from exposure to toxic chemicals -reduced public health and safety risks from exposure to toxic chemicals -reduced environmental exposure to toxic chemicals Increased revenue from TUR improvements in processes and products Activities of TURA program agencies in other regulatory and non-regulatory programs Benefits to non-TURA firms in Massachusetts from TURA program resources Value of TURA data to public data users in the Commonwealth	

Figure 15 Summary of TURA Costs ($ 1995 - millions)

	1990	1991	1992	1993	1994	1995	1996	1997
Compliance Costs:								
Preparing Form S	0	2.0	1.4	1.3	1.2	1.1	0.9	0.9
Preparing TUR Plans	0	0	0	0	5.9	0.4	3.6	0
Form S Filing Fees	0	2.2	5.2	5.2	4.7	5.6	2.7	6.6
Other TURA Fees	0	0.001	0.03	0.05	0.08	0.08	0.06	0.04
Capital Costs:								
Capital Expenditures	0.4	1.0	1.5	2.2	4.0	4.3	6.5	7.2
Total	$0.4	$5.3	$8.1	$8.7	$15.9	$11.4	$13.8	$14.8

One other benefit was monetized in the Abt study. Since the program's inception, TURA agencies have received 12 federal grants, totaling $2,527,615 ($2,288,638 in 1995 dollars), to support TUR activities in the Commonwealth above-and-beyond those efforts funded directly by TURA fees. These grants are included in the analysis as benefits of TURA because they have been leveraged by the TURA program and have benefited the Commonwealth. Appendix B presents a list of these grants.

Figure 16 Net Changes in the Operating Costs of TURA Filers Resulting from TURA Activities

($ 1995- Positive values indicate reductions in costs)

	1990	1991	1992	1993	1994	1995	1996	1997
Total Operating Cost Changes Due to TURA (millions)	$6.0	$12.7	$9.1	$9.2	$9.7	$11.0	$10.2	$11.9

Improved protection of human health and the environment is expected to result from TURA as facilities identify and implement toxics use and emission reduction opportunities through TURA planning and reporting activities. The results of the Abt Associates telephone survey indicate that 70% of respondents identified TUR opportunities as the result of [their] 1994 TUR plans and 81% respondents have or will fully implement at least a few of the projects selected for implementation in their 1994 plans. Many of these TUR activities will reduce the risks associated with exposure to toxic chemicals for workers, the public, and the environment.

The benefit-cost analysis did not, however, monetize the benefits of human health and ecological risk reduction due to the difficulty in isolating, measuring, and then monetizing impacts resulting from TUR. Instead, the analysis provided examples of chemicals for which quantitative data

from Form S indicate use or emission reductions that would likely reduce human health and ecological risk. One such example – an analysis of reductions of ethyl acetate releases and sulfuric acid use on occupational health and safety – is presented in Appendix D.

Abt's analysis did acknowledge that in many cases toxics use, byproduct and emission reductions documented in Form S submissions cannot be attributed solely to TURA. TURA is only one of several initiatives within the past decade that have encouraged reductions in the use and release of toxic chemicals. Other major initiatives include the federal Toxics Release Inventory (EPCRA, section 313), the federal EPA's "33/50" program, and the international "Montreal Protocol" (global treaty on protection of the ozone layer). While the benefit-cost report did not attempt to credit specific toxics use, byproduct and emission reductions to TURA, it did examine the differences between TURA and the other three major toxics reduction initiatives just mentioned. This analysis points to TURA's unique niche among these intitiatives and the likelihood that TURA's contributions to the reductions achieved in Massachusetts have been significant. The phone survey conducted by Abt Associates found that 89 % of respondents felt that the TUR planning process contributed to the implementation of TUR.

The benefit-cost analysis identified, but was unable to monetize, four additional categories of benefits of TURA:

1. increased revenue from TUR improvements in processes and products;
2. activities of TURA program agencies in other regulatory and non-regulatory programs;
3. benefits to non-TURA firms in Massachusetts from TURA program resources; and
4. the value of TURA data to public data users in the Commonwealth.

Therefore, the results of the monetized benefit-cost analysis should be considered in conjunction with the examples of human health and ecological benefits, as well as the other non-monetized benefits.

3. CONCLUSIONS

This final section considers the six policy goals of the Toxics Use Reduction Act in light of the findings of the program evaluation. The section concludes with a look at the implications for improvements to the TURA program that arise from the evaluation.

3.1 Is the TURA Program Meeting the Six Policy Goals of the Act?

Answer: The TURA program has made significant progress toward meeting the goals of the Act.

The findings of the evaluation provide aN information source for examining whether and how the six policy goals of TURA are being met. Each goal is discussed in turn.

Goal 1. To establish for the Commonwealth a statewide goal of reducing toxic waste generated by fifty percent (50%) by the year 1997 using toxics use reduction as the means of meeting this goal [Section 13 of the Act establishes a base year of 1987 for this goal]

It is not yet possible to determine whether this goal will be reached since TURA waste or byproduct data are only available for the period 1990 to 1995 and since the results of efforts to estimate the 1987 baseline are inconclusive. What can be said, however, is that the TURA data indicate a very significant reduction of 30% in byproduct resulting from TUR during the period 1990-1995. This period represents five years of reporting by TURA firms, where byproduct reductions averaged 6% per year.

Goal 2. To establish toxics use reduction as the preferred means for achieving compliance with any federal or state law or regulation pertaining to toxics production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics, or releases of toxics into the environment and for minimizing the risks associated with the use of toxic or hazardous substances and the production of toxic or hazardous substances or hazardous wastes

Through the DEP's FIRST multimedia inspection program, Massachusetts is making strides toward establishing toxics use reduction as the preferred means of achieving compliance with the environmental laws – federal and state – under its purview. A goal of the FIRST program is to promote compliance through TUR. This evaluation found that when TUR *was* addressed in an inspection, results were impressive. However, the evaluation also found several notable shortcomings of the FIRST program in a small sample of firms, namely: inadequately trained inspection staff, a lack of rigor in inspections, and recommendations for TUR in a minority of cases. These findings suggest that improvements to the FIRST program will be necessary to fully realize Goal 2 of TURA.

As detailed in Appendix A Mandates and Accomplishments (see Administrative Council, line 314 of Act), TURA agencies have been working with other agencies to help promote TUR in non-environmental regulatory programs such as those focused on worker health and safety and on radioactive wastes. While the impact of these efforts cannot be assessed from this evaluation, the program is aware that more work needs to be done to promote the TUR approach in these areas.

The benefit-cost analysis of the TURA program examined the ways in which toxics use reduction translates into reductions in risk to workers, the public and the environment. For a handful of "indicator" chemicals, the study documented reductions in byproduct, use and emissions that appear to be a result of TUR and linked these changes to potential improvements in human and ecological health. While this analysis is far short of a full risk assessment of TURA it does provide a snapshot for considering the impact of TURA on risk.

Goal 3. To sustain, safeguard and promote the competitive advantage of Massachusetts business, large and small, while advancing innovation in toxic use reduction and management

There are basically two types of competitive advantage: lower cost and product differentiation. A firm can achieve lower cost advantage if they have the ability to design, produce and market a product more efficiently than their competitors. Product differentiation can be achieved if a firm can provide unique and superior value to a buyer through product quality, special product features, or after-sale service.[13]

This evaluation provides evidence that firms are indeed lowering their production costs through TUR. Sixty seven percent of survey respondents that had reported implementing TUR said that they actually saw direct cost savings (e.g., on materials use or waste disposal) and 66% reported that they realized improvements in worker health and safety. Aside from the value of worker health and safety in human terms, this benefit of TUR can translate into increased productivity (through decreased absenteeism), reduced costs of medical and employee compensation insurance, and liability; all leading to lower production costs. While only a minority of respondents reported reduced regulatory compliance requirements (45%) this number is not insignificant considering the financial benefits of reduced regulatory costs.

Analysis of TURA data and data from the survey and in-depth investigation show that toxic byproduct, i.e., waste, generation per unit of output is declining as a result of toxics use reduction implementation, indicating increased production efficiency among those firms implementing TUR. Again, this increase in efficiency leads to lower production costs which either maintain or enhance price competitiveness.

---

[13] Porter, M.E., The Competitive Advantage of Nations, New York: Free Press, 1990.

Additional evidence of the financial benefits of TUR was found in the analysis of investments in TUR projects in the in-depth investigation. For 12 firms that stated that they implemented TUR projects as a result of preparing their TUR plan, the aggregate ratio of net savings to capital investment for these projects was roughly 7 to 1. These investments are doing well to contribute to the lowering of production costs and hence the competitiveness of these firms.

The program evaluation sheds some light on the question of the effect of TUR on product differentiation. Thirty eight percent of survey respondents stated that TUR has improved their firms environmental image and 27% claim TUR created a marketing advantage. Considering that these advantages may bring significant competitive advantage to the companies that realize them, these results are significant for this environmental program. However, a notable majority of survey respondents answered that company concern with impact on product quality was an important factor in their company's decisions not to implement TUR projects. In a related question, a total of 44% of respondents said that customers not accepting change in the product was either a very or somewhat important barrier to TUR. These responses suggest that a significant number of firms may be held back from pursuing TUR in certain cases because of concerns with product quality and possibly the competitive positioning of their products. This result may not be so surprising. While technically there are numerous process or product changes that firms "could" pursue – to reduce toxics use, to lower material costs, to save energy, etc. – many of these changes could not be made without adversely affecting product quality. This result may, however, point to the need for continued research on alternative chemicals and process technologies.

Goal 4. To promote reductions in the production and use of toxic hazardous substances within the Commonwealth, both through the programs established in section three of this act and through existing toxics-related state programs

Good progress is being made toward this goal. From 1990 to 1995 toxic chemical use, (i.e., the sum total of chemicals manufactured, processed or otherwise used) dropped by 20% as a result of toxics use reduction. The survey found that 60% of facilities decreased their use of toxic chemicals per unit of total production since 1990. This evaluation establishes a strong connection between these reductions and the programs and resources of the TURA program by documenting the significant impact that planning under TURA and other program resources have had on motivating or assisting firms to implement TUR. The evaluation cannot, however, draw conclusions about the impact of other state regulatory programs on progress in toxic chemical production and use reductions.

Goal 5. To enhance and strengthen the enforcement of existing environmental laws and regulations within the Commonwealth

By incorporating a multi-media focus into its regulatory enforcement programs, DEP has made significant strides toward increasing the effectiveness of enforcement efforts. FIRST (Facility Wide Inspections to Reduce the Sources of Toxics) inspections simultaneously check for

compliance with applicable environmental rules for air, industrial wastewater, hazardous waste, and TURA.

The TURA agencies, and OTA in particular, have lent their expertise to a number of important programs aimed at strengthening a variety of state and federal environmental regulatory programs. For example, OTA has played a major role in the nationally recognized Massachusetts Printers' Partnership (a DEP initiative with the Printing Industries of New England to put in place a new regulatory mechanism for this industry); OTA provided comment to EPA on how the agency's enforcement programs might dovetail with technical assistance activities, OTA provides regular consultation to EPA on a number of initiatives including the Environmental Leadership project and the President's XL program; and TURI and OTA representatives have been actively involved in EPA's Common Sense Initiative program designed to streamline regulatory programs in a number of key national. industries.

Goal 6. To promote coordination and cooperation between all state departments and agencies administering toxics-related programs.

The TURA agencies have undertaken many joint efforts with other state entities involved in toxics-related programs. Figure 17 summarizes a number of these efforts.

Figure 17 Joint Efforts Between TURA Agencies and Other State Entities

State Entity	Project
Attorney General's Office	Structured enforcement actions to favor TUR over end-of-pipe emissions controls
Division of Energy Resources	Secured three National Industrial Competitiveness through Energy, Environment and Economics (NICE3) program awards
Industrial Finance Authority	Develop funding sources for companies to implement TUR
Bay State Skills Corporation/Industrial Services Program and the Massachusetts Manufacturing Partnership	Provide TUR assistance, information and training to small and medium-sized manufacturers in Massachusetts
Department of Public Health	Coordination of laws and regulations governing radionuclides
Department of Procurement and General Services	Promote state purchases of environmentally friendly products
Executive Office of Economic Affairs, Massachusetts Office of Business Development, U. Mass.	STrategic Envirotechnology Partnership aimed at supporting innovative environmental technology companies in Massachusetts
Executive Office of Environmental Affairs	Integrate TUR into Clean State Initiative efforts to bring all facilities into compliance with environmental laws and regulations
University of Massachusetts	Provide encouragement and assistance to the Center for Environmentally Appropriate Materials at Lowell and the National Environmental Technology for Waste Prevention Institute at Amherst, and a new graduate training program in "Cleaner Production and Pollution Prevention" at the Lowell campus.
Massachusetts Water Resources Authority	Participate in the Mercury Workgroup aimed at reducing use and releases of mercury in the region served by the MWRA

3.2 Implications from the Evaluation for TURA Program Improvements

The survey of large quantity toxics users posed the question, "What would you change about the TURA program." Respondents offered a wide range of suggestions for improving TURA: Twelve percent recommended eliminating the program while 14% recommended leaving it unchanged. The responses are summarized in Figure 18 (The full text of open-ended responses can be found in the Abt survey report).

Figure 18 Survey Responses to the Question "What would you change about the TURA program"

Open-ended responses	*Percent of facilities**
Reduce paperwork burden/Simplify process	19%
Change toxics list (e.g., make Form S=Form R, exclude chemical manufacturers, exclude metals use)	16%
Reduce/Eliminate/Restructure fees	14%
Nothing	14%
Eliminate it	12%
Change reporting threshold/Too difficult for small businesses	6%
Other	40%

*Percentages do not add to 100 because facilities provided more than one response. Total facilities = 340.

Responses included in "other" could not be grouped into categories that were specific enough to accurately convey their meaning. They are summarized below:

Flexibility

- Increase the flexibility of the program; allow exemptions (14 responses)
- Recognize that some toxic chemicals have no alternatives for certain uses (9)
- Address industry-specific or company-specific concerns (8)
- Make the program voluntary (4)
- Recognize that some industries or facilities can only improve so much before reaching a plateau (2)

Definition of Terms

- Change/clarify the definition of "unit product" (5)
- Change/clarify the definition of "by-product" (5)
- Change/clarify/expand the definition of recycling (2)

Administration

- Electronic filing of TURA data (4)
- Offer alternative nontoxic products (1), technologies (1), or substitutes (3)
- Eliminate certification or certified planner (5)
- Establish better communication between government and industry (2)
- Devise toxicity rating system, or method that recognizes relative toxicity (2)
- Make reporting required annually (1), every three years (2), every five years (2)

While suggestions from survey respondents provide valuable input for improving the TURA program, other results from throughout the evaluation provide implications for program improvements as well. These include:

- **Outstanding mandates.** Not all of the TURA mandates have been fulfilled. Unfulfilled mandates include: the consolidation of all reporting on chemical use, release and disposal; and development of an electronic system for filing TURA data.

- **Barriers to TUR.** The evaluation sought to elucidate barriers to TUR implementation. Based on the survey results, the most significant barriers appear to be company concern with impact on product quality, and customers not accepting change in the product. This barrier should be examined further, particularly to determine whether major technological gaps exist that impede firms from pursuing TUR.

- **Rewarding Leaders; Encouraging the Others.** Clearly many firms are making good progress toward toxics use reduction and others are finding the task more difficult. Consideration should be given to rewarding leaders and focusing resources on those firms that have not achieved great success with TUR.

- **Small Quantity Toxics Users.** The evaluation shows good progress in toxics use reduction among those firms subject to the requirements of TURA. It is not clear that the smaller quantity toxics users in the Commonwealth are making the same progress.

- **Other Areas of Human and Environmental Impact.** TURA is focused on reducing the adverse impacts of toxic chemical use by the industries covered by the Act. It appears that there may be great benefits if firms applied the principles of TUR planning to other important areas with environmental and health consequences, e.g., water use, energy use, the impact of the product when used, recycled, and discarded by consumers.

Appendix A
Analysis of TURA Mandates

ADMINISTRATIVE COUNCIL

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
314/Identify all federal or state laws and regulations on chemical production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics and release of toxics to the environment. Determine and promote coordination of laws needed to foster TUR.	1/1/91 and annually thereafter	OTA prepared report in 1991 identifying federal and state laws and regulations TURI prepared report in 1994 ("Regulatory and Practical Barriers to Toxics Use Reduction in Massachusetts") The Council established an interagency task force in 1994 to identify priority areas for TUR promotion DEP, OTA, and TURI have assisted other agencies and industrial groups to coordinate laws, compliance, and enforcement activities to promote TUR	Identification of federal and state laws and regulations was delayed by a lack of Council staff until 1994, when a full-time Director was hired. Significant progress towards this goal was made in the 1994 TURI report, which continued the work begun in the 1991 OTA report. The 1994 TURI report has earned praise from P2 officials nationally. One goal of the program is to extend the focus of TUR promotion beyond DEP. TURA agencies have been working with other agencies to help promote TUR since the startup of the TURA program, by: communicating with the Mass. Safety Council to integrate TUR into worker safety programs; working with DPH on coordination of laws and regulations governing radionuclides; integrating TUR into the efforts of the Clean State initiative to bring all facilities into compliance with environmental laws and regulations; work with the Watershed initiative to integrate TUR; helping develop the Printer's Partnership to use TUR as a mechanism to assist printers in understanding and complying with environmental standards; assisting DEP with the Environmental Results Program to remove permitting barriers to TUR; working with OSHA to integrate TUR into its inspection and compliance work; and providing comment on all regulations and policies to maximize opportunities to coordinate laws and promote TUR. <u>Supporting Documentation</u> Report prepared by OTA in 1991 Report prepared by TURI in 1994 ("Regulatory and Practical Barriers to Toxics Use Reduction in Massachusetts")

ADMINISTRATIVE COUNCIL

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
323/Identify all state agency and POTW toxics reporting requirements and recommend needed standardization and coordination.	1/1/91	OTA prepared report in 1991 identifying federal and state laws and regulations TURI prepared report in 1994 ("Regulatory and Practical Barriers to Toxics Use Reduction in Massachusetts") Provided input to DEP regarding industrial wastewater regulations and staffing needs/ opportunities for coordination and consolidation Assisted in the Warren project (see assessment)	Efforts are now underway at DEP to address areas of overlap in POTW reporting and permitting regulations/procedures. The Warren project assisted a small POTW in developing an automated tracking system that allowed it to identify waste streams causing non-compliance. The project also assisted the POTW in working with a large industry to use TUR as a mechanism to reduce wastes and meet effluent standards without expansion of the POTW. <u>Supporting Documentation</u> -Report prepared by OTA in 1991 -Report prepared by TURI in 1994 ("Regulatory and Practical Barriers to Toxics Use Reduction in Massachusetts")

ADMINISTRATIVE COUNCIL

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
338/Policy Recommendation Report to Governor on TUR, implementation of the Act, expenditures from TUR fund, and achievement of increased toxics use reduction. Copy filed with Clerks of House and Senate.	1990 and annually thereafter	Council has produced and filed an annual report in 1994 and annually thereafter	Report includes recommendations to the Governor to support TUR, a summary of action taken to implement TURA, and a breakdown of TUR fund expenditures. Production of an annual report was delayed until 1994 by lack of full-time Council staff. Initial recommendations were very useful in calling attention to the fact that TURA fees were being diverted to the M.G.L.c. 21E hazardous waste site cleanup program: the Governor successfully took action to stop this diversion in the following year's budget. <u>Supporting Documentation</u> -Administrative Council on Toxics Use Reduction 1994 Annual Report -Administrative Council on Toxics Use Reduction 1995 Annual Report
345/May comment on draft regulations pertaining to toxics production and use, hazardous waste, industrial hygiene, worker safety, public exposure to toxics, or release of toxics to the environment. May also provide Advisory Board with opportunity to comment.	*ongoing*	Since 1994, the Council and the TUR Advisory Board have been very active in providing comment on regulations	The Council and the Advisory Board have provided comment on a variety of regulations including: modifications to DEP's air regulations for printers and aqueous cleaners; and policies adopted and regulations promulgated pursuant to the federal Clean Air Act Amendments of 1990. The Council and the Advisory Board have also provided comments on projects such as DEP's Printers Partnership and EPA's Common Sense Initiative. <u>Supporting Documentation</u> -Regulation Comment Letters -Policy Comment Letters

ADMINISTRATIVE COUNCIL

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
351/May recommend to the Advisory Board the formation of ad hoc committees.	*ongoing*	First Ad Hoc Committee formed in 1992 Advisory Board now has additional standing committees	The Administrative Council recommended additional standing committees and it provides staff support Supporting Documentation Committee meeting minutes
489/File copy of TURI's report on potential chemical restrictions with Clerks of House and Senate and Joint Committee on Natural Resources and Agriculture. Must hold a public hearing.	1/1/93	Done in January 1993	Supporting Documentation Toxics Use Reduction Institute, "Toxic Chemical Management in Massachusetts, An Analysis of Further Chemical Restriction Policy," 1993.
898/Promulgate regulations identifying "priority user segments" (up to 3 per year) for achieving TUR. Regulations shall be based on recommendations from OTA and DEP, and developed in consultation with TURI.	7/1/95 and annually thereafter	Execution pending DEP's promulgation of user segment regulations	

ADMINISTRATIVE COUNCIL

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
594/Promulgate regulations for adding CERCLA chemicals to TUR list.	1/1/91	Regulations promulgated in Fall 1991	The TUR list has been updated annually since 1994 to adjust for changes in the federal lists. Policies were enacted by the Administrative Council in 1995 to increase the predictability and practicability for TURA filers of TUR list chemical additions/deletions due to changes in federal chemical lists. Supporting Documentation -Regulations -Council policies on TUR list changes
594/May promulgate regulations to add and/or delete not more than ten chemicals per year from the TURA list effective calendar year 1994. DEP and DPH shall recommend chemical changes. The Admin. Coun. shall consult with TURI.	*ongoing*	Advisory Board has heard petitions to delist certain chemicals and has granted some of these petitions	The Advisory Board was appointed in 1992?. Beginning in 1995, the Council began consideration of a number of requests for the delisting of TUR list chemicals. In 1996, the TURA program delisted six metal alloys and chromium three oxide. the Council declined to delist sodium hydroxide and butyl benzyl phthalate. Supporting Documentation -Meeting minutes of the Science Advisory Board -TURI recommendations regarding delisting petitions -Meeting minutes of the Administrative Council
1223/Promulgate regulations Adjusting Filing Fee to raise $5 million for reporting year 1990.	11/1/90	Regulations promulgated in Fall 1990	
1470/Annually verify DEP's compliance with trade secret protection requirements.	ongoing	Checks have been made periodically through the DEP Commissioner's office	

ADVISORY BOARD

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
390/Provide forum for discussion on implementation of TURA.	ongoing	Regular meetings	The Science Advisory Board met monthly until 1995, when it switched to bimonthly meetings. Supporting Documentation Meeting minutes of the Science Advisory Board
393/Establish and administer annual "governor's toxics use reduction award" to recognize outstanding individual and organizational, public and private achievement in TUR.	1990 and annually thereafter	Awards issued in 1994 and annually thereafter	Startup delayed until 1994 due to lack of full-time Council staff. Program needs more publicity for awardees. Supporting Documentation Awards ceremony booklets from 1994, 1995, 1996
397/May create ad hoc advisory committees on issues pertaining to the implementation of TURA.		First committee established in 1992 Other standing committees established	Standing committees on the following topics: Governor's Awards Program, TUR data, user segments, Form S and Plan Update reports, TURA fees. Supporting Documentation -Meeting minutes

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
1264/Issue TURA fee waivers to small businesses. Prepare annual report to Administrative Council on all waivers issued.	ongoing	63 requests received since FY '91, 54 received with waiver payment plan	

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
211/Identify all DEP requirements for reporting on chemical use, release and disposal, and to maximum extent possible standardize consolidate, and coordinate these to the maximum extent possible.	1/1/91	One-stop reporting effort is underway	1. TUR Reporting Package was developed the first year of TURA program 2. DEP is exploring several possibilities for one-stop reporting: a. DEP has submitted an XL Project proposal to EPA to develop a consolidated annual reporting form for all facilities. This would include all annual reports, source registration, annual industrial wastewater summary, RCRA biennial reporting, and TUR and TRI reporting. In order to integrate state and federal reporting requirements, DEP needs EPA to grant some regulatory flexibility. b. Massachusetts is in the running for an EPA pilot program that will develop one-stop reporting in three states. The pilot will seek to integrate local, state, and national reporting requirements into a single process. DEP is reexamining the need for each piece of data requested via reporting. <u>Supporting Documentation</u> TUR Reporting Package
216/Make information on uses of toxics available by computer to the public and other agencies.		1.TUR data extracts put on Internet 2. TUR data also accessible through DEP's Facilities Master File (FMF)	1. Home page for TURA program, created in 1995, gets 100-150 hits per month: **http://www.magnet.state.ma.us/dep/bwp/dhm/tura** 2. Data extract files put on FMF annually, beginning in 1991
228/May seek uniform reporting and enforcement authority from EPA.		DEP has not sought delegation for TRI reporting or enforcement	A state regulation requires TURA filers to submit a copy of their Form R to DEP. If filers fail to do so, DEP enforces this as a violation of state regulations.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
237/Develop and implement multi-media inspections.	1/1/92	Implemented FIRST program (multimedia inspections)	Completed as pilot project in 1991; implemented across DEP in 1992; program has received national recognition and awards
244/Develop and implement policies that ensure to the maximum extent practicable that sources out of compliance with DEP regulations use TUR rather than treatment to return to compliance.	beginning 1/1/91	Policies developed and implemented encouraging Regional Offices to look at P2 (not just TUR) in all enforcement actions	Uniform policy *encouraging* this has been adopted throughout BWP (IWW, hazardous waste, solid waste, air) DEP's standard letter for all Notices of NonCompliance (NON's) includes language to identify potential source reduction opportunities and is designed to be used whenever enforcement action is taken against a facility where there may be ways of coming into compliance through the implementation of source reduction or TUR <u>Supplemental Documentation</u> Standard Cover Letter for All Notices of NonCompliance, BWP Policy #BWP-95-012
269/Promulgate Regulations Classifying Production Units in User Segments.	1/1/92	Development of user segment regulations started in 1994; completion expected in FY '97	DEP has worked with multi-stakeholders through the TURA Advisory Board, OTA and TURI to develop, draft and promulgate user segment regulations. Promulgation expected early April, 1997.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
273/Compile, summarize, and analyze plan summaries and reports. Submit Annual Report on TUR progress to Administrative Council and House and Senate Clerks.	1992 and annually thereafter	TUR data entered into FMF/ plan summaries produced in 1994; Annual Report filed with Legislature	Statute is clear on data compilation and plan summary preparation; less clear on required analysis or on content of Annual Report.
279/May at reasonable times enter into premises to investigate records, conditions, or practices required under TURA.		DEP has exercised this authority	DEP conducts on average 1,000 inspections annually and each of these includes review for TURA compliance. Supporting Documentation *Protocol B* (Guidance Document for FIRST inspections) is under development
648/Promulgate regulations creating supplemental form for information not submitted under EPCRA.	1/1/91	Regulations promulgated in 1991	Completed on time Supporting Documentation Form S
751/Establish systems for electronic filing of annual reports.	1/1/92	Not yet developed	Budgetary problems have prevented development of TURA-specific system. DEP is exploring agency-wide electronic filing.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
754,842/May promulgate regulations broadening the reporting requirements for facilities in priority user segments to include small quantity toxics users and toxics users with fewer than 10 FTEs. The latter group may also be required to plan.	*beginning 7/1/95*	Not yet undertaken	In reorganization of DEP, BWP may create separate subdivisions to deal with large businesses, small businesses/consumer groups. Such a restructuring would allow for increased attention to SQTUs.
769/Specify Criteria for TUR Plans and Plan Summaries.	1/1/91	Regulations promulgated in 1993 Plan and plan update guidance documents published	Regulations adopted 2 years behind schedule. Regulations reviewed regularly and updated when necessary. <u>Supporting Documentation</u> Plan Guidance document
848/Must allow large quantity toxics user (no more than) 90 days to fix good-faith deficiency in TUR plan.			DEP has taken over 250 enforcement actions against *intentional* plan deficiencies (failure to submit data, pay fee, etc.), for a rate of approx. 10% of the TUR universe annually. <u>Supporting Documentation</u> -DEP enforcement actions on file -TUR enforcement guidance document is under development
861/Promulgate TUR Planner Certification Regulations.	1/1/91	Regulations promulgated in 1993	Completed (2 years behind schedule)

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
861/Offer TUR Planner Certification Examination and begin certifying Planners.	1/1/92	Examination and certification program established in mid-1993	Completed (1 1/2 years behind schedule)
890/Compile goals of all TUR plans.	9/1/94 and annually thereafter	Publication of goals with annual TURA evaluation	Supporting Documentation -DEP TURA data release reports -"Progress Toward Byproduct Reduction Goal of the Toxics Use Reduction Act," Executive Report, 1995
892/Prepare report comparing Large Quantity Toxics Users' goals stated in the Plans to statewide 50% reduction in byproduct goal. File with Administrative Council, Clerks of the House and Senate, and the Joint Committee on Natural Resources and Agriculture.	1/1/95	Report issued 1995; Publication of goals with annual evaluation and release of TURA information	Supporting Documentation "Progress Toward the Byproduct Reduction Goal of the Toxics Use Reduction Act", Executive Report, 1995
931,1024/May refer toxics users to OTA.	*ongoing*		ongoing

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
960/May seek authority from the Administrative Council to promulgate toxics use performance standards for priority user segments.	*beginning 7/1/95*	None yet completed	Not possible until user segments are defined
989/May issue administrative orders establishing performance standards for individual toxics users within a priority user segment.	*beginning 7/1/95*	None yet completed	not possible until user segments are defined
1006/May apply to Council for authority to extend performance standard for a user segment to small quantity toxics users within the segment.		None yet completed	Not possible until user segments have been defined
1032/May order any toxics user who violates an emissions standard to prepare a certified TUR plan.		Orders to implement TUR have been issued via enforcement actions	Enforcement actions have not required preparation of formal TUR plans. Actions have required companies to identify and evaluate pollution prevention or TUR options.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
1059/Promulgate regulations for Toxics Use Reduction Waivers of permit conditions that promote TUR.	1/1/91	No regulations promulgated yet, several waivers have been granted	Ongoing; completion anticipated by fiscal year 1997
1089/Monitor implementation and effectiveness of TUR techniques approved for facilities granted TUR waivers.		None yet completed	Not possible until TUR waiver regulations are promulgated
1106/Suspend or revoke waivers where good faith TUR efforts are lacking.		None yet completed	Not possible until TUR waiver regulations are promulgated
1123/Develop procedures for responding to Citizen Petitions requesting DEP review of a company's TURA plan and issuing findings.	1/1/92	Procedures not yet developed	No Petitions have yet been filed
1173/Send Toxics Use Survey to industry.	4/1/90	Done	Survey sent to 15,000 firms and evaluation completed
1193/Analyze results of toxics use survey.	10/1/90	Done	Analysis determined size of TURA filer universe was smaller than anticipated. As a result, filing fees were adjusted.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
1241/Publish in Massachusetts Register annual adjustment to filing fee, equivalent to increase in the Producer Price Index.	beginning 4/1/92	Never done	
1247/Impose an additional administrative fee for failure to file a complete and accurate toxics use survey or to pay any fee pursuant to this section in a timely manner.			Companies must pay double fees if they fail to file and come forward. If they are discovered by DEP, they must pay double fees plus a penalty.
1318/Promulgate Annual TUR reporting and Trade Secret regulations and forms.	1/1/91	Regulations promulgated and forms developed	Done
1330/Upon petition, must review plan-related information for which trade secret confidentiality is claimed.		DEP has never asked for verification of trade secret confidentiality claim	Only 8-10 companies have claimed trade secret confidentiality

DEPARTMENT OF ENVIRONMENTAL PROTECTION

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
1423/May include trade secret information in the aggregate in publicly available database.		Information has been included	To protect confidentiality, information is only included if at least three companies use the chemical involved
1428/Establish a secure area for confidential materials and information and designate a chief document control officer.		Confidential materials locked in safe	Few employees have the combination to the safe <u>Supporting Documentation</u> Letter from Commissioner limiting authority for access to safe

OFFICE OF TECHNICAL ASSISTANCE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
526/Provide technical assistance to toxics users in implementing TUR and complying with the statute.	ongoing	1. Telephone assistance to thousands of companies. 2. More than 1,400 site visits to more than 650 companies. 3. Presentations, clinics, workshops (see examples in next column, item 6).	1. OTA receives thousands of calls annually; it used to track the number of calls, but stopped when this task became overwhelming. 2. Over the lifetime of the TURA program, less than half of OTA's site visits have been to companies that are TUR filers (FY 1991: 43%; 1992: 64%; 1993: 51%; 1994: 46%; 1995: 43%; 1996: 31%). Roughly half the site visits are return visits, indicating the development of a longer-term relationship with companies. 3. OTA estimates it has reached a combined audience of as many as 20,000 people at all of these events. More than half of OTA's presentations are made at conferences or meetings of trade associations, chambers of commerce, professional engineering societies, etc. 4. Reports on topics including: EPA grant projects; Central MA P2 project (which won a Ford Foundation award); Merrimack project (cited by EPA as influencing EPA mindset), OTA has a regular column in Manufacturers Mart, 40 case studies exist and more are under development 5. To aid compliance and help identify TUR opportunities, OTA staff have developed 4 computer programs and simple spreadsheets to help companies track chemical use and costs, calculate emissions from degreasers, and calculate VOC content and emissions from coating operations. 6. Presentations, clinics, workshops -- sponsor or co-sponsor of more than 200; presented 200 more. Examples: annual Statewide series "Making Compliance Work for You" on compliance with Clean Air Act and TUR opportunities for compliance (1995); facilitator of national sector-specific teleconferences for small businesses on requirements of the Clean Air Act Amendments (1994, '95 and '96); several workshops on general TUR opportunities with POTWs across the state (1990-96).

OFFICE OF TECHNICAL ASSISTANCE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
526/Provide technical assistance to small quantity toxics users.	ongoing	1. Telephone assistance 2. Site visits 3. Presentations, clinics, workshops 4. Reports	1. (See above entry) 2. More than 50% of OTA"s site visits are to SQTUs. Some SQTUs are referred by enforcement agencies; others are proactive and/or responding to OTA outreach efforts. 3. OTA has undertaken outreach efforts to numerous types of SQTUs: schools (OTA received a federal grant for this; it pioneered outreach on the connection between IAQ and chemical use issues in schools); laboratories (university and research; OTA was the first to address laboratory waste reduction at an American Chemical Society convention from an environmental, not just safety perspective); auto repair shops (with DEP); dry cleaners and industrial laundries; municipalities (regarding household hazardous waste); hospitals; machine shops; and lawn care providers. OTA has also worked extensively with POTWs. <u>Supporting Documentation</u> OTA publications
530/Establish criteria for prioritizing assistance to users in priority user segments and to users which have been referred to the office by the DEP		1. Priority given to TURA filers, referrals from enforcement agencies for current consultations; 2. "User segments" have not been finalized, so no priorities set yet.	For company OTA is currently working with, priority assistance is given to TURA filers and referrals for compliance or enforcement reasons; for companies that do not fall into either of these categories, assistance is given on first-come, first-serve basis.

OFFICE OF TECHNICAL ASSISTANCE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
536/ Provide outreach to small businesses required to report and plan as a result of prioritization.	ongoing	Not yet done because "user segments" have not been prioritized.	OTA's efforts are contingent upon the definition of priority user segments that include small businesses.
538/Assist first time filers with reporting requirements and trade secret submissions.		1. Developed and jointly ran (with DEP and TURI) annual training sessions, workshops, clinics on reporting and filing requirements. 2. No requests for assistance on trade secret submissions.	1.OTA has been a key player in planning, organizing and financing these events on filing and reporting in collaboration with DEP and TURI. OTA developed the modules on financial aspects, materials accounting, and process characterization. OTA's attendance records do not track first-time filers, but OTA estimates that 50 percent of first-time filers have attended these workshops. 2. OTA has never received a request for assistance from a trade secret filer.

OFFICE OF TECHNICAL ASSISTANCE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
540/Coordinate activities with private sector initiatives where feasible.	ongoing	1. OTA helped 3 Ma. manufacturers win $1.2 million total in federal grants through NICE3 program; 2. Working with trade assoc's on conferences, workshops; 3. Provide technical guidance/support for STEP program; 4. Established the Northeast Business Environmental Network (NBEN); 5. Active member of MWRA's Mercury Work Group with hospitals; 6. Joint project with Mass. Manu. Partnership; 7. Key involvement in TURA program with three colleges for TUR internship and curriculum program	1. OTA, in collaboration with Division of Energy Resources, is providing administrative and technical support of applications to the federal National Industrial Competitiveness through Energy, Environment and Economy (NICE3) program. MA companies won 2 of 16 national grants awarded in '96. 2. OTA worked with the RadTech Foundation to sponsor UV curing workshop for printers and coaters. UV technology is a low-solvent, lower energy coating alternative; OTA sponsored a conference with American Society for Quality Control on the role of TUR in ISO 14000 and influenced ASQC's decision to establish a standing committee on P2. 3. OTA provides technical assessment for emerging envirotechnologies and increased private-sector participation in pilot demonstrations for STEP assistance. 4. Under the federal grant for the Merrimack Project, OTA founded and provided initial support for the NBEN, a business-government partnership aimed at promoting TUR as means of improving both the environment and the economy. OTA remains on the Board of Directors; 5. OTA worked with MWRA on a project involving 28 hospitals in Greater Boston to reduce mercury loading from hospitals to the MWRA system. OTA helped develop a data base of mercury reduction techniques and co-wrote source reduction sections of a handbook. 6. OTA, DEP, TURI working with the Massachusetts Manufacturing Partnership to assist manufacturers to make connection between environmental improvements and competitive advantages. "Better, Faster, Cheaper and Cleaner Manufacturing in Massachusetts," a two-year project, is focusing specifically on the metals and electronics sectors. 7. OTA helped lay groundwork for this effort between TURA and several state colleges This program provides TUR interns for companies in southeastern Massachusetts.

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
411/Submit to the council a set of operating guidelines.		Submitted as strategic plan in 1990	
414/Establish cooperative programs with other public and private colleges and universities designed to augment the Act's implementation.		Participated in establishing: -the Pollution Prevention Consortium of New England Universities -the Southeastern Pollution Prevention Consortium (Cape Cod Community College, Massachusetts Maritime Academy, University of Massachusetts Dartmouth), development of curriculum for TUR certificate program Participate in the National Pollution Prevention Roundtable's Education and Training Workgroup	TURI joined with ten other universities, EPA, and NEWMOA in establishing the P2 Consortium, whose goals include information exchange and collaborative efforts for P2 funding. TURI has received 2 grants from the P2 Consortium: one for developing a voc-tec TUR curriculum, the other for developing a set of pollution prevention homework problems for university-level engineering courses SE P2 Consortium institutions offer environmental certificate programs in wastewater treatment, waste site cleanup, and coastal zone management. TURI is working with colleges to develop an environmental certificate program in TUR. The National Pollution Prevention Roundtable's Education and Training Workgroup meets twice yearly to exchange curricular ideas <u>Supporting Documentation</u> -Voc-tec course curriculum -"Motivating Pollution Prevention Concepts: Homework Problems for Engineering Curriculum"

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
422/May establish fees, tuition, or other financial charges for its programs.		Fee structure established	TURI has set fees for the following programs: - the 48-hour TUR Planner course ($200 for TURA filer companies, $1200 for non-TURA filers) -laboratory workshops ($50 for half day workshop, $100 for full day) -TURI charges administrative fees for the delivery of continuing education courses and workshops. The fees cover the cost of materials and facility rentals, but do not include the costs of curriculum development. TURI does not charge for the following: The Clean Sites demonstration project workshops (free if not counted towards TUR Planner re-certification credits), P2/TUR research by the TTC for industries and the general public, testing of suitability of non-toxic cleaning solvents by the Surface Cleaning Laboratory
433/Provide general information about and actively publicize advantages and developments in TUR and the requirements of the Act.	beginning 1/1/92	Published numerous technical and policy reports, articles, brochures, including *"TURP Talk"* - a TURA newsletter for Toxics Use Reduction Planners	TURI has an active outreach effort to publicize public events, e.g., Cleaner Technology Demonstration Sites, the awarding of Governor's awards for Toxics Use Reduction TURI is active in presenting numerous TUR topics at conferences, trade shows and in schools <u>Supporting Documentation</u> -Issues of *"TURP Talk"*

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
436/Establish conferences, courses, events, publications, reports, etc. and work in cooperation with OTA to provide information to toxics users.	beginning 1/1/92	TURI holds numerous events each year. The Institute has put on numerous conferences, events, workshops, and classes for all audiences in numerous TUR topics Published "*PEP Talk*" in conjunction with OTA - a newsletter covering TUR planning issues Publish *TURP Talk*	In fiscal year 1996, for example, events included: 2 sections of the TURP course, 3 one-day Continuing Education Conferences for TUR planners, 5 joint workshops with DEP and OTA on the TUR plan updates, 2 TURA program-wide strategic retreats, and piloted a vocational education environmental technician program curriculum. Supporting Documentation -*PEP Talk* issues -*TURP Talk* issues -conference fliers and proceedings

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
440/Develop and provide curriculum and training on TUR for higher education students and faculty.	beginning 1/1/92	Created the Cleaner Production Masters and Doctoral Programs in the Work Environment Dept. at UMass Lowell. Currently includes courses on toxics use reduction and cleaner production. Developed a book of pollution prevention homework problems for use in engineering courses Developed curriculum for teaching modified TURP course in vocational-technical programs Taught modified TURP course in vocational-technical program at Minuteman Regional Tec-Voc HS in 1995	<u>Supporting Documentation</u> -"Motivating Pollution Prevention Concepts: Homework Problems for Engineering Curriculum" -Cleaner Production Masters and Doctoral program (UMass Lowell) brochure -course curriculum for "Introduction to Cleaner Production" -copy of voc-tec curriculum

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
442/Engage in research, development and demonstration of TUR methods	beginning 1/1/92	Research at TURI is divided into three areas: technical, methods, and policy research, including: *1. technical research and demonstration* -Cleaner Technology Demonstration Sites Project -Matching Grants Program -Surface Cleaning Laboratory -Research Fellows program -Projects funded by outside grants to develop solvent alternatives for industrial cleaning	The Cleaner Technology Demonstration Sites Project features public workshops at five sites across the state that are implementing TUR/ cleaner production. Through July 1996, 85 people had attended open visits to the sites; 75 people attended the Project's kickoff event. The Matching Grants Program: see description under TURI Mandate #461 Research Fellows program: TURI annually funds UMass graduate students performing technical, methods, or policy research work relevant to TUR. EPA provided TURI with a grant to evaluate the technical and economic feasibility and environmental and occupational safety of alternatives to 4 solvents used in metal degreasing operations: methylene chloride, perchloroethylene, 1,1,1-trichloroethane, and trichloroethylene.

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
442/[continued] Engage in research, development and demonstration of TUR methods	beginning 1/1/92	-Surface Cleaning Laboratory -Tufts University Hazardous Materials Management Program capstone projects *2. methods research* -chemical substitution analysis -Total cost analysis -Measuring toxics use reduction progress using TURA and TRI data *3. policy research* -program evaluation -chemical restriction policies -survey of P2 planning programs -government and industry collaboration	Surface Cleaning Laboratory: TURI operates a research and testing laboratory that evaluates the effectiveness of different aqueous-based cleaning chemistries and equipment on a variety of substrates and soils. Services are available to Massachusetts industries seeking help with alternatives to processes such as vapor degreasing and solvent-based cleaning. Information from laboratory findings is kept on file and is available to the manufacturing community. TURI has promoted graduate-level TUR research by serving as the "client" for several Tufts University student projects that have examined TUR issues/methods. For several chemicals, TURI has conducted studies to identify their process/production uses in MA, the substitutes available for each of those processes, and the potential problems associated with each substitute. TURI has conducted a statistical analysis of TRI and TURA data to provide a rational basis for developing Institute research priorities and to inform MA TUR regulatory policy TURI sponsored five total cost analysis case studies of alternatives to vapor degreaser chemistries in metal degreasing operations TURI is currently evaluating the TURA program based on quantitative data (TUR and TRI data) and qualitative data (interviews with facilities subject to TURA reporting) TURI published two reports on chemical restriction policies in MA. The 1993 report explored the use of voluntary and economic as well as regulatory public policy measures for restricting the use of chemicals. The 1995 report evaluated the role of chemical restriction policies in MA given the state's experience with TURA. TURI performed a survey of five states that implemented P2 planning programs, in order to increase understanding of the factors that make a planning program successful.

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
442/[continued] Engage in research, development and demonstration of TUR methods	beginning 1/1/92		TURI sponsored a report that identified new industry-government collaborative models Supporting Documentation -*Summary of TURI Research Work* (January 1994) -Clean Sites Demo Project fliers [and reports?] -Matching Grants: grant applications, research reports -Research Fellows reports: see attached list of publications -[report on EPA-funded project?] -Surface Cleaning Laboratory brochures, reports -chemical use analysis reports for: cadmium, cyanide, methyl ethyl ketone, styrene, trichloroethylene -Tufts Capstone Project reports on Toxics Use in Biotechnology, Toxics Use in Photovoltaic Manufacturing -chemical substitution analysis reports: Alternatives to Solvent-Based Paints, Alternatives to Solvent- and Petroleum-Based Inks, Alternatives to Ethylene Glycol Ethers [others?] -1996 Measuring Progress report: analyzes chemical use and byproduct generation by facility, industry sector, and production unit categories -1994 total cost analysis case studies -*Toxic Chemical Management in Massachusetts: An Analysis of Further Chemical Restriction Policies* (1993) -1995 report -*Pollution Prevention and Waste Reduction Planning: A Quick Look at Initial State Experience* -*Models for Industry-Government Collaboration on Pollution Prevention*
448/In consultation with other agencies, develop and offer TUR planner course.	beginning 7/1/91	The 27th full TUR Planner course is being offered in January 1997	TURP courses are offered twice yearly at locations around the state. Supporting Documentation -training curriculum; updated syllabus; case studies

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
461/Sponsor research or pilot projects on innovative TUR technologies and make information available to the public.	beginning 1/1/92	Research Fellows program Matching Grants program Surface Cleaning Laboratory Clean Sites Demonstration Project Microscale chemistry training	TURI's in-house expertise covers a broad range of industries and specialties: pulp and paper production, textile engineering, chemistry, industrial hygiene, environmental engineering. Because the Institute is looking to broaden its focus beyond solvent substitution/ cleaning, in FY 97, TURI technical research will emphasize the printed circuit board industry. TURI's Industry Matching Grants Program provides MA industries with direct funding for TUR feasibility and technology studies. Awards range from $1,000 to $25,000. In FY 1997, the Cleaner Technology Demonstration Sites Project and the Matching Grants Program were combined into a third program whose funding level is $60,000. TURI funds the development and use of microscale chemistry procedures in both organic and inorganic chemistry to promote TUR in educational laboratories. <u>Supporting Documentation</u> -Matching Grants project reports -Microscale chemistry manuals

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
466/May assist in the training of inspectors and other key toxics personnel, of so requested by the department		TURI provided TUR training to DEP inspectors TURI, with the Northeast Waste Management Officials Association, provided TUR training to DEP middle managers TURI helped DEP design the waste prevention section of the FIRST curriculum for multi-media inspections; TURI also helped DEP to teach pilot courses In 1995 TURI and OTA conducted training on P2 and permitting TURI provided TUR training to 32 MWRA employees.	TURI has developed and delivered customized training to DEP staff. Furthermore, TURI allocates 2 to 4 seats in each TURP course for DEP or OTA employees. <u>Supporting Documentation</u> -FIRST curriculum -list of DEP employees trained by TURI -NEWMOA middle manager curriculum

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
468/Provide TUR training and assistance to citizens, community groups, workers, labor representatives, local government boards and officials on understanding reports and plan summaries, citizen petitions, and enforcement activities pursuant to TURA.	beginning 1/1/92	The Community Education Program in TUR awards Toxics Use Reduction Networking (TURN) Grants to community groups and municipalities for, projects aimed at encouraging community involvement in TUR. In FY 1997, 11 grants were awarded REM2 project for high school students Public interest advisory board Sponsorship of John Snow Inc.'s Community Roundtable for municipal officials	

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
475/Take advantage of available information from existing state and federal programs on TUR and P2.		TURI participates in a variety of national and international programs, including the National Pollution Prevention Roundtable Technology and Transfer Center collects material and information from existing state and federal programs and clearinghouses TTC actively seeks out electronic sources of TUR and P2 information (e.g., Internet) P2Gems project to identify other resources on TUR and P2	The TTC maintains the largest collection of material on TUR and P2 in New England. Materials are available for public review. The TTC conducts research to identify sources of information on TUR technologies/ methodologies for regulated industry and, resources allowing, for the general public.
478/Report to Administrative Council on potential chemical Restrictions.		Two reports issued	<u>Supporting Documentation</u> -"Toxic Chemical Management in MA: An Analysis of Further Chemical Restriction Policies," "Toxic Chemical Management in MA: The Second Report on Further Chemical Restriction Policies"

TOXICS USE REDUCTION INSTITUTE

LINE IN ACT/MANDATE	STATUTORY DEADLINE	TASKS, PROGRAMS, ACTIVITIES IMPLEMENTED	ASSESSMENT, SUPPLEMENTAL INFORMATION
510/Consult with the Science Advisory Board (SAB) on various issues.			SAB got off to a late start (September 1993). Board has been dealing with a backlog of delisting petitions (6 have been considered so far). It is hoped that in FY 97 the Board will finish addressing delisting petitions and turn its attention to other suggested activities, including: selection of a methodology for prioritizing chemicals by degree of toxicity, helping TURI set research priorities <u>Supporting Documentation</u> -meeting minutes -delisting petitions -SAB recommendations

Appendix B
Grants Received by the TURA Program for TUR Activities

Grant Title[1]	Year Awarded	Grantor	Grantee	Grant Amt.
Critical Parameter Grant	1991	U.S. EPA	OTA	$100,000
Merrimack River Grant	1991	U.S. EPA	OTA	$120,000
Buzzards Bay Pollution Prevention Grant	1992	U.S. EPA	OTA and Mass. Coastal Zone Mgmt. Office	$ 65,000
TUR for Dry Cleaners	1992	U.S. EPA	TURI	$ 50,000
Clean Alternatives Project	1993	U.S. EPA	TURI	$140,765
Clean States Incentive Grant	1994	U.S. EPA	OTA	$100,000
Chemical use Reduction for Improved Indoor Air in School	1994	U.S. EPA	OTA	$ 60,000
Reducing Discharges from Business and Homes	1994	U.S. EPA	OTA	$ 20,000
Alternative Clothes Cleaning: Training Curriculum Development	1994	U.S. EPA	TURI	$110,000
Pollution Prevention Education and Assistance in Low Income Area Schools	1995	U.S. EPA	OTA	$ 40,000
Demonstration of "Near Zero" VOC Lithographic Ink Blanket Wash Systems	1995	U.S. EPA New England	TURI	$ 52,850
NICE[3] -- 3 Grants at $425,000 each[2] -Erving Paper -Brittany Printing and Dyeing -ThermoTrex	 1995 1996 1996	Dept. of Energy	OTA	$1,275,000
Autobody Grant	1996	U.S. EPA	OTA	$105,000
Total Grants:				$2,238,615

Notes: 1. For a description of these grants, see The Commonwealth of Massachusetts, Executive Office of Environmental Affairs, "Massachusetts Administrative Council on Toxics Use Reduction, Fiscal Year 1995 Annual Report," December 14,
2. OTA reviewed and selected projects for grant proposals and assisted companies in preparing grant applications. Awards were made to companies.

Appendix C
Two Case Studies of Toxics Use Reduction Planning[14]

TUR Planning Case Study I: Plastic Extruder

When faced with the task of preparing a TUR plan for zinc metal, Plastic Extruder's TUR planner formed a TUR team as a subcommittee of the company's safety committee. The TUR team was comprised of the company's production manager, engineers, purchasing staff, supervisors, and workers from the extrusion department. Team members met several times over three months to pinpoint TUR opportunities in the company's plastic extrusion process. The team developed three TUR options: (1) enclose the batching operation where zinc losses are greatest (zinc is mixed in powdered form with other raw materials in the batching operation), (2) improve zinc material handing and processing to reduce zinc byproduct, and (3) find a substitute for zinc where possible (zinc acts as an activator in the sheet extrusion process).

Plastic Extruder implemented each of the options. The first two changes did not have a significant overall impact on total zinc use at the facility (<5%) but did have a positive impact on worker health and safety. Zinc dust in the process is dispersed during handling and transfer processes. By improving materials handling and segregating the zinc transfer area from the rest of the production area, zinc dust in the plant was greatly reduced. Furthermore, the dust that was created could be more readily reused in the process. Quantitative cost/benefit data on these two projects was not available from the firm. The third option reduced zinc use by 20% per batch. The substitute raw material cost was less expensive reducing raw material costs approximately $25,000 per year (in 1995 dollars).

The 1994 plan cost the company $20,730 to prepare. Team members worked 220 management level hours on the plan at $78.04/hour and approximately 101 employee hours at $23/hour. The company hired a general practice planner to certify the plan for approximately $2,000. The net present value analysis of Plastic Extruder's planning efforts totaled $100,366 (using a 12% discount factor, a 5% inflation factor, 10-year project life-time, and a 40% corporate tax rate).

TUR planning motivated Plastic Extruder to reorganize its environmental, health and safety (EHS) function. The EHS functions had been split between several persons. As a result of the plan, the company decided a full-time EHS coordinator would better serve the firm's EHS needs. Planning also lead to the institution of an informal chemical screening program. The company now screens chemicals it introduces on to the production floor in an effort to protect employees from harmful materials. According to the firm's production manager, these changes increased good will between the company and neighbors of the company's industrial park. Many of the workers on the TUR team and affected by the changes instituted at Plastic Extruder live in the

---

[14] These case studies were taken from Greiner Environmental "In-Depth Investigation of Toxics Use Reduction in 25 Massachusetts Firms," March 1997.

community surrounding the plant.

While some firms find employees resistant to change work practices or formulations, Plastic Extruder, Inc. found the reverse. The company regularly involves workers in total quality management (TQM) efforts -- even inviting workers to give presentations on projects they have designed and implemented themselves. The firm's production manager noted the similarity between the TUR planning process the company's own TQM program. Both systems involve significant management commitment and employee involvement. As the production manager put it, "*preparing the TUR plan looked a whole lot like what we do all the time here at (Plastic Extruder).*"

TUR Planning Case Study II: Automotive Supplier

Through TUR planning and work with the TURA Program, Automotive Supplier, Inc. has markedly improved its bottom line position and reduced the impact of its manufacturing activities and products on the environment. What synergy between the company and the TURA Program made this company achieve such notable results?

Automotive Supplier, Inc., a big three auto company supplier, faced severe financial crises in the early 1990's. The company was under pressure from its Detroit customers to simultaneously reduce product costs and improve product quality. To meet these demands, company managers sought gains in every department. However to the surprise of many, some of the companies biggest improvements came out of the firm's environmental improvement initiatives. Led by the Director of Environmental Affairs, Automotive Supplier initiated numerous projects to eliminate toxic-chemical cleaning steps, reduced equipment down time, and improve product yield. The Environmental Affairs Director (who is also the company's TUR planner) attributes his firm's TUR success to his work on TURA and the agencies that administer it.

A good example of the synergy between TURA and management objectives at Automotive Supplier is the preparation of the company's toxics use reduction plan. The Environmental Affairs Director saw that the team-based approach recommended in the TURI planner course fit perfectly with his company's team-based approach to safety and quality. The Director organized six TUR teams at the plant, one for each of the company's production units, and began a series of monthly worker/supervisor/management meetings. The teams set goals, evaluated their processes, brainstormed TUR techniques, and tested and implemented numerous TUR changes. The following is an excerpt from the company/s TUR Plan Mission Statement:

> *"....Our highest priority will be the proactive exploration of cost effective processes changes which will reduce or eliminate the use and/or generation of toxics at the point of production....We strongly support this concept and encourage all employees to forward their suggestions and recommendations for helping to reduce our reliance upon toxic substances. The safety and health of our employees is of major concern and can be enhanced by this program. Those that are toxic use*

reduction team members are empowered to make suggestions and to participate in the plan development. As part of the hiring and job promotion process, employees and candidates who are knowledgeable in plan work and are willing to participate will be given additional consideration. Because of the importance of this program, effective work in this areas will be recognized by executive management and additional incentives may be authorized as economic conditions permit."

Automotive Supplier's TUR team targeted all TURA materials in the facility, regardless of their level of use. The planning committee defined nine work centers and industrial processes for TUR analysis. These processes represented over 90% of the company's air emission and hazardous waste generation. The results from several of these analyses are presented below.

1. The *chlorination system* control circuits and piping as well as the cylinder control valves were upgraded primarily to benefit worker, health and safety to reduce. The changed reduced chlorine exposure and chlorine byproducts by roughly 100 lb. All thought the net present value of this investment was negative, the company decided that the investment's qualitative benefits outweighed its quantitative costs.

2. *Trichloroethane degreasing* was eliminated at Automotive Supplier in two ways. First, the company purchased an aqueous degreasing system. The aqueous system eliminated a large portion of the work cleaned in the company's solvent degreaser. Second, the company looked upstream to its suppliers and requested that they use vanishing oil in their operations. Vanishing oil does not need to be removed by a separate operation -- saving the company time and money.

3. *Acid and caustic* mold cleaning was eliminated. As a result of its TUR analysis, the company purchased a "dry ice" (CO_2) system to clean the molds. The dry ice cleaning process can be performed at the rubber press in minutes -- a significant time-improvement over the chemical-intensive process that required moving the molds off-line for cleaning.

Unlike some firms that passively approach planning, Automotive Supplier set aggressive TUR goals -- for example chemical elimination in several cases. The company held TUR team meetings for an entire year prior to when the 1994 TUR plans were due. Rather than pursue TUR opportunities for only those substances that require TURA reporting and planning, Automotive Supplier has focused its efforts on all TURA materials -- regardless of the quantities of use at the plant. TUR team meetings did not end with the completion of the firm's plan. The teams have met every month continuously since 1993.

The net present value of Automotive Supplier's 1994 TUR plan was calculated to be $359,284. The company reduced its annual toxics use by more than 191,000 lb. per year. These benefits came because the company made significant capital and labor investments. Automotive Supplier, Inc., spent over $171,000 on capital equipment. The company purchased equipment to modify its chlorination process, zinc oxide and barium dispensing process, as well as its mold washing cleaning process. The company's TUR planning efforts cost the firm $150,138. These

costs were comprised of management, technical, production, and clerical labor.

- $32,216 in management labor (400 hours at $ 78.04 per hour)
- $114,172 in technical labor and production worker labor (1,946 hours at $58.67 per hour)
- $4,750 in clerical labor (200 clerical hours at $23.75 per hour)

The company's TUR planner attributes his firm's TUR success to education, networking and technical assistance provided by the Toxics Use Reduction Institute and the Office of Technical Assistance. The planner has taken TURI sponsored courses, attended TURA program workshops, had numerous consultations with OTA and received two TUR ideas from a DEP multimedia inspection. According to the planner, TURA helped grow Automotive Supplier's business. TURA has helped to reduced manufacturing costs, redesign processes, and made the work environment safer for employees.

Appendix D

An Analysis of Reductions of Ethyl Acetate Releases and Sulfuric Acid Use on Occupational Health and Safety[15]

Introduction

The benefit-cost analysis did not monetize the benefits of human health and ecological risk reduction due to the difficulty in isolating, measuring, and then monetizing impacts resulting from TUR. Instead, the analysis provided examples of chemicals for which quantitative data from Form S indicate use or emission reductions that would likely reduce human health and ecological risk. This is one such example, excerpted from the benefit-cost study report, authored by Abt Associates.

Chemical Release

Workers are put at risk both from chronic exposure to toxic chemicals and from acute exposure resulting from accidental spills and releases. A primary route of chronic exposure is inhalation. Worker exposure to volatilized chemicals or to particulates results, largely, from "fugitive emissions". Fugitive emissions are chemical releases to air that are *not* released through a confined air stream, such as a vent. For example, fugitive emissions result from equipment leaks and evaporative losses.

This analysis draws on data available from TURA to identify reductions in fugitive emissions that result from TUR. Fugitive emission reductions are presented for a single chemical - ethyl acetate - that serves as a case study of TURA benefits. Ethyl acetate was chosen for two reasons. First, it is not subject to reporting under the 33/50 program or TRI and was not phased out under the Montreal Protocol. The fact that these other major government programs do not apply to ethyl acetate allows for segregation of the effects of TURA from these programs. Second, ethyl acetate is a volatile chemical, with relatively high levels of reported fugitive emissions.

Ethyl acetate is used as a general solvent in coatings and plastics and in smokeless powders, pharmaceuticals, and synthetic fruit essences. It is toxic by inhalation and skin absorption as well as an irritant to eyes and skin. The National Institute for Occupational Safety and Health (NIOSH) has set a recommended exposure limit of 400 ppm for ethyl acetate.

---

[15] Taken from Abt Associates, "Benefit-cost Analysis of the Massachusetts Toxics Use Reduction Act (TURA), "December 2, 1996.

This analysis evaluated reductions in fugitive emissions of ethyl acetate due to TUR in four steps:

(1) Select facilities that reported fugitive emissions of ethyl acetate in Federal Form R.

(2) From the facilities selected in Step 1, choose those that reported use of a TUR technique (Form S, Section 3.3) for ethyl acetate. Exclusion of records not indicating a TUR technique narrows the analysis to reductions in fugitive emissions that are potentially related to TURA.

(3) For each of the facilities selected in Step 2, calculate the fugitive emissions of ethyl acetate on a production-normalized basis in each reporting year as:

$$PFE = FE/FPI$$

where:

PFE	=	Production-normalized fugitive emissions of ethyl acetate;
FE	=	Total fugitive emissions of ethyl acetate (from Form R, Section 5.1); and
FPI	=	Facility production index for ethyl acetate (from Form R, Section 8.9).

(4) For each year, determine the number of facilities that indicated a TUR technique *and* decreased fugitive emissions of ethyl acetate on a production normalized basis.

Reductions in fugitive emissions are evaluated on a production normalized basis to address the question of the *benefits of TURA*. Changes in emissions that track changes in production quantity are likely to result from economic forces unrelated to TURA. TURA techniques generally alter the production process, and are reflected in emissions per unit. Note, however, that in some cases, TURA may also result in reduced production of goods produced using toxic chemicals in favor of more "environmentally-friendly" goods.

Also, note that this method of evaluating reductions in fugitive emissions does not capture cases of complete substitution for ethyl acetate. Facilities that substituted a less toxic chemical for ethyl acetate would no longer be subject to TURA reporting for ethyl acetate. Therefore, such facilities would not be included in this assessment of benefits.

Forty-four facilities in Massachusetts filed a Form S for ethyl acetate in reporting years 1990 through 1994. Thirty-nine of the 44 reported fugitive emissions between 1990 and 1994. Twenty-three of these facilities reported using a TUR technique for ethyl acetate in at least one year. As shown in Figure D-1, most of the TUR techniques affected processing operations and involved input substitution, improved operation and maintenance, or product reformulation.

Figure D-1 TUR Techniques Implemented to Reduce Ethyl Acetate Use

TUR Techniques	Materials Handling/Storage	Processing Operations	Finished Goods Handling
Input Substitution	1	9	1
Product Reformulation	2	7	0
Product Unit Redesign or Modification	0	1	0
Production Unit Modernization	1	3	0
Improved Operation and Maintenance of Production Unit Equipment and Methods	1	8	0
Recycling, Reuse, or Extended Use of Toxics	0	1	0
Management Technique of Using Byproduct as Product	0	0	1
Miscellaneous	2	6	0

Of the twenty-three facilities indicating a TUR technique, six did not report sufficient production data to calculate production-weighted emissions. Of the remaining seventeen facilities, nine indicated a reduction in production-weighted fugitive emissions for a year the facility listed a related TUR technique (See Figure D-2). These emission reductions may reduce worker exposure to ethyl acetate.

Figure D-2 Production Weighted Emission Reductions of Ethyl Acetate (1990-1994)
For 9 of the 23 facilities indicating a TUR technique for Ethyl Acetate

Year	Percent Reduction of Fugitive Air Emissions per Year					# of Unique Facilities
	1-20	21-40	41-60	61-80	81-100	
1990-1994	2	5	1	1	2	9

In addition to the benefits associated with reductions in the quantity of ethyl acetate emitted per unit of production, benefits will result from facilities substituting entirely for ethyl acetate. Seven of the 44 facilities that filed a Form S for ethyl acetate between 1990 and 1994 fell below TURA reporting thresholds for ethyl acetate by 1994. These facilities cannot, however, be distinguished between those experiencing production shut downs and those implementing TUR techniques.

Chemical Use

Workers may also be exposed to toxic chemicals as a result of accidental releases and dermal

absorption of minute doses of chemical. The chemical use data reported in Form S can be used to gauge these risks. Data on chemical use indicates the chemicals to which a worker is *potentially* exposed on the shop floor. Actual exposure depends on process controls and exposure controls as well as the frequency and nature of chemical accidents. Neither the federal Occupational Safety and Health Administration nor the Massachusetts Department of Labor and Industries require firms to report annually on chemical use in such a way that government authorities might be able to predict potential worker exposure to chemicals of concern.

Data from TURA and TRI can be used to estimate reductions in toxic chemical use that result from TUR. In this analysis, use reductions are presented for sulfuric acid, as an example of TUR progress. Sulfuric acid was chosen for two reasons: (1) it is one of the most widely used industrial chemicals in Massachusetts; and (2) the TURA program offices have provided assistance to numerous facilities in reducing the use of sulfuric acid.

Sulfuric acid is used to manufacture a wide variety of chemicals and materials including fertilizers, paints, detergents, and explosives, and is used in wastewater treatment.

Health hazards resulting from acute exposure to sulfuric acid by exposure route are:

- inhalation: eye, nose, throat irritation;
- ingestion: pulmonary edema, bronchitis;
- direct skin or eye contact: emphysema, conjunctivitis, stomatis, dental erosion, tracheobronchitis, skin or eye burns, dermatitis.

This analysis evaluated reduction in use of sulfuric acid in four steps analogous to those presented above for fugitive emissions:

(1) Select facilities that reported processing or "otherwise using" sulfuric acid in Form S.

(2) From the facilities selected in Step 1, choose those that reported use of a TUR technique (Form S, Section 3.3) for sulfuric acid.

(3) For each of the facilities selected in Step 2, calculate the amount of sulfuric acid processed/otherwise used on a production weighted basis in each reporting year as:

$$PU = U/FPI$$

where:

PU = Production-normalized process/use of sulfuric acid;
U = Total quantity of sulfuric acid processed/used (from Form S, Section 1, 1.2b and 1.2c); and
FPI = Facility production index for sulfuric acid (from Form R, Section 8.9).

(4) For each year, determine the number of facilities that indicated a TUR technique and decreased use of sulfuric acid on a production normalized basis.

Two hundred thirty-six unique facilities in Massachusetts filed a Form S for sulfuric acid process/otherwise use in reporting years 1990 through 1994. Ninety-four of these facilities reported using a TUR technique for sulfuric acid in at least one year. As shown in Figure D-3, most of the TUR techniques affected processing operations and involved improved operation and maintenance, recycling/reuse, or product unit modernization.

Figure D-3 TUR Techniques Implemented to Reduce Sulfuric Acid Use

TUR Techniques	Materials Handling/ Storage	Processing Operations	Finished Goods Handling
Input Substitution	1	15	0
Product Reformulation	1	5	0
Product Unit Redesign or Modification	1	13	0
Production Unit Modernization	2	23	0
Improved Operation and Maintenance of Production Unit Equipment and Methods	10	65	2
Recycling, Reuse, or Extended Use of Toxics	1	29	0
Management Technique of Using Byproduct as Product	0	8	0
Miscellaneous	3	22	0

Of the 94 facilities indicating a TUR technique, 9 did not report sufficient production data to calculate production-normalized use. Of the remaining 85 facilities, 74 decreased their production-normalized use of sulfuric acid for a year the facility listed a related TUR technique. These use reductions lessen the risk to workers associated with exposure to sulfuric acid. Figure D-4 indicates the distribution of the percent, production normalized reductions in chemical use experienced by the 74 facilities that listed a TUR technique. For example, in 12 cases between 1990 and 1994 production normalized use of sulfuric acid was reduced by greater than 60 percent. These reductions may have occurred at separate facilities or at the same facilities but in separate years.

Figure D-4 Production Normalized Use Reductions of Sulfuric Acid (1990-1994)

Year	Percent Reduction of Total Use					# of Unique Facilities
	1-20	21-40	41-60	61-80	81-100	
1990-1994	62	35	14	10	2	74

In addition to the benefits associated with reductions in the quantity of sulfuric acid used per unit of production, benefits will result from facilities substituting entirely for sulfuric acid. Fifty-two of the 236 facilities that filed a Form S for sulfuric acid process/otherwise use between 1990 and 1994 fell below TURA reporting thresholds for sulfuric acid by 1994. These facilities cannot, however, be distinguished between those experiencing production shut downs and those implementing TUR techniques.

As mentioned above, a risk assessment linking changes in use and emissions to reductions in adverse health effects was not possible. However, data on the cost of avoiding illnesses related to sulfuric acid exposure provide evidence of the potential economic benefits associated with reductions in sulfuric acid use. Valuation of the benefit of sulfuric acid use reduction can be based on society's willingness-to-pay to avoid the risk of related illnesses.

For example, the National Institute of Occupations Safety and Health indicate that one symptom of contact with sulfuric acid is emphysema. The direct medical costs of treating a case of emphysema have been estimated by the U.S. Environmental Protection Agency (see *The Medical Costs of Five Illnesses Related to Exposure to Pollutants*, EPA, 1993.) The results of this analysis suggest that avoiding one case of emphysema would result in the avoidance of an average lifetime cost of treating emphysema of $24,000 ($1995, 7 percent discount rate). This estimate excludes non-medical direct costs (e.g., child care, housekeeping expenses) and indirect costs of illness (e.g., decreased productivity of patients, pain and suffering of patient and family/friends). Thus, an estimate of all benefits of avoiding a single case of emphysema from exposure to sulfuric acid is likely to substantially exceed the $24,000 estimate.

In summary, reduced exposure to sulfuric acid is expected to reduce cases of emphysema and other occupational health and safety impacts. To the extent that TUR reduces worker exposure to sulfuric acid, benefits will accrue to society. While this analysis estimates the medical cost of a single case of emphysema, the number of avoided cases and types of illness are unknown and therefore the total benefits of TUR for this chemical and outcome are not monetized.